Researching the Effectiveness of Agricultural Programs: An Analysis of Conservation Engagement in Four Great Lakes Watersheds

Task 4c: 2020 Survey Report

Authorship and Funding Details

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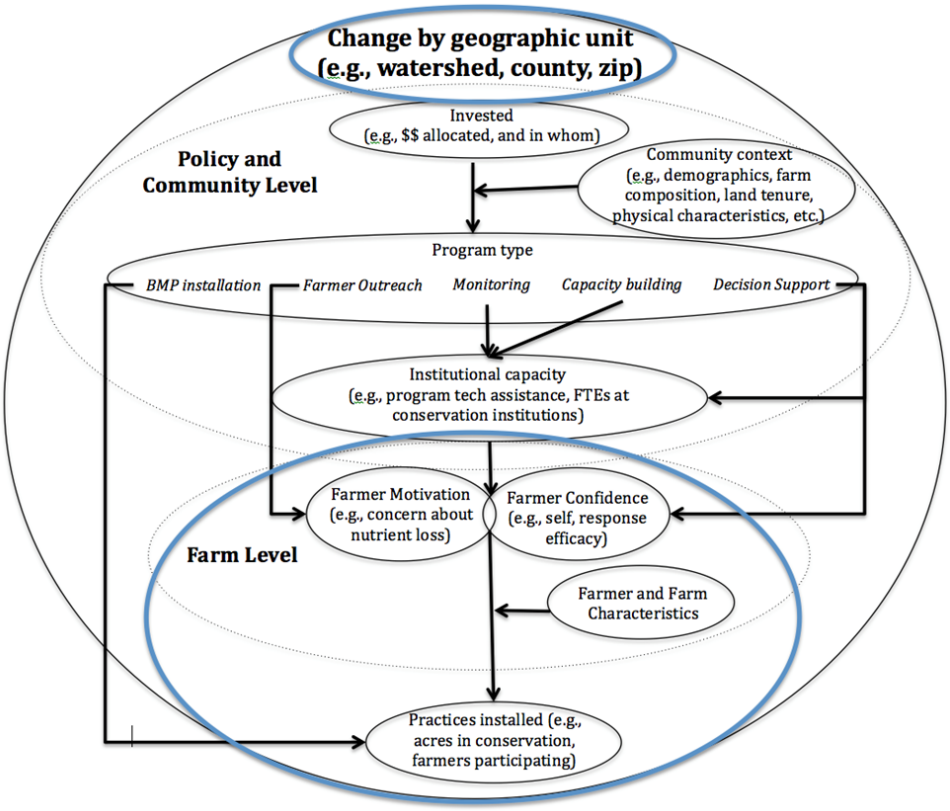
Executive Summary

Overview

Agricultural producers in the Great Lakes Basin have received over $100 million from the Great Lakes Restoration Initiative for agricultural conservation practices intended to influence on-farm decision making and improve water quality. The data presented in this report is one component of a GLRI-funded project using socio-economic analytics to evaluate the effectiveness of those federal incentives. The project uses multiple indicators of success to better understand obstacles and opportunities for enhancing on-farm decision-making to improve water quality (see Fig. 1).

Figure 1. REAP Conceptual model highlighting the components of this analysis (blue circles)



The goal of the analyses presented here are to build on the preliminary analysis included in the report, *Researching the Effectiveness of Agricultural Program: Evaluating Survey Data in the Maumee and Saginaw* Watersheds, in which existing survey data was insufficient to make comprehensive comparisons between four EPA priority watersheds. A new survey instrument was developed in 2018 and administered in winter 2019 to identify ways to improve future GLRI investments so that they better account for the needs of the local farming populations, and their unique motivations and constraints (see Appendix A for the full survey).

The results summarized here identify ways to improve future conservation program investments that better account for the needs of the local farming populations, and their unique motivations and constraints. With this data we aimed to answer three specific research questions, a summary of the answer to each question is included below:

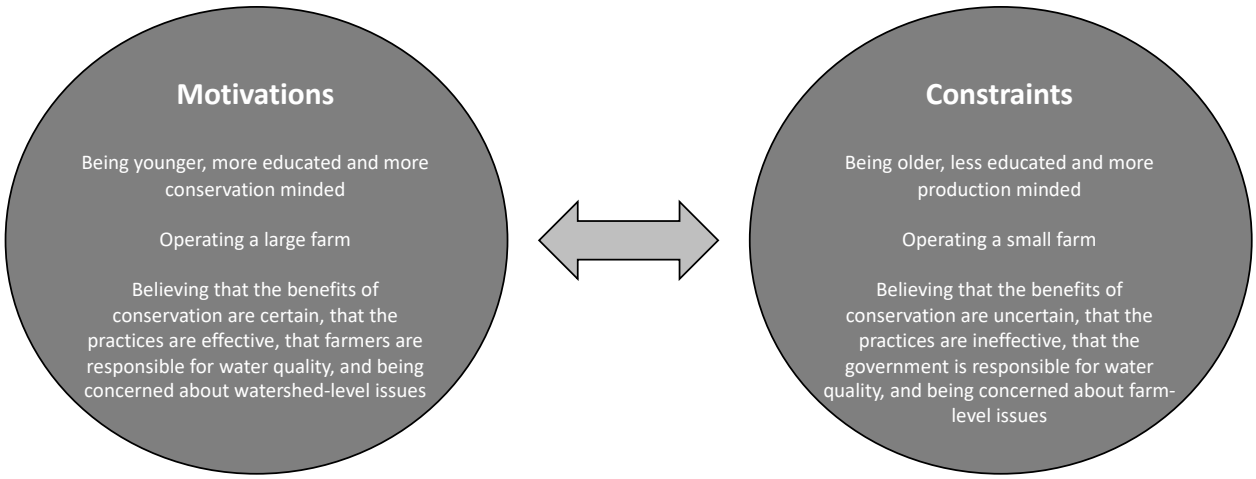
(1) *How do the priority watersheds differ in their farm and farmer characteristics, beliefs, and conservation adoption?* The priority watersheds are fairly similar in a lot of ways with high adoption rates, a strong conservation identity, a strong sense of responsibility for water quality, and an interest in doing more to engage in conservation. They also shared similar demographics in terms of age, education and experience. However, key differences emerge that can be taken into account when determining what types of investments will be the most impactful in each particular watershed (see Table 1).

Table 1. Summary of priority watershed differences

Genesee farmers report the highest cover crop use, the lowest perceived barriers, and greatest belief in cover crop effectiveness. They are also the least unsure about future program participation and have bigger farms on average but a greater commitment to engaging in conservation despite challenges. Perhaps because adoption rates are so high, Genesee farmers tend to report fairly low concern about nutrient loss from agriculture and future regulation.	**Maumee farmers** report the greatest level of concern about a variety of challenges that impede participation in conservation and are the most likely to believe that agriculture is not the main driver of water quality issues. For cover crops, they report being limited by a variety of barriers and have generally lower belief in effectiveness. The Maumee has a lot of small farms and farmers relying on off-farm income, with less diverse rotations, more reliance on fertilizer applicators for guidance, and higher participation in programs.
Lower Fox farmers report being the most informed about conservation, have the highest GLRI participation rates, and are most likely to believe that their quality of life depends on a healthy watershed. Similar to the Genesee, Lower Fox farmers are less concerned than Saginaw and Maumee farmers about nutrient loss from agriculture and future regulation.	**Saginaw farmers** have less rented land on average and are the most unsure about future government program participation despite being the least concerned about program barriers. The Saginaw watershed has a lot of small farms and farmers relying on off-farm income, with less diverse rotations, more reliance on crop advisors for guidance and higher participation in programs.

(2) *What socio-psychological factors are driving adoption of recommended practices?* Several clear drivers of conservation practice implementation emerge. Several are related to farmer characteristics such as being more conservation minded, younger, and more educated. Others are related to beliefs that farmers hold (regardless of age, education, etc), including belief in the benefits and effectiveness of the proposed practices, and feeling a sense of personal responsibility and concern for the watershed. The figure below demonstrates what factors tend to increase motivation to engage in conservation (on the left) versus what tends to decrease motivation (on the right) (Fig. 2).

Figure 2. A summary of the key motivations and constraints explaining why individuals do or do not use cover crops and buffers

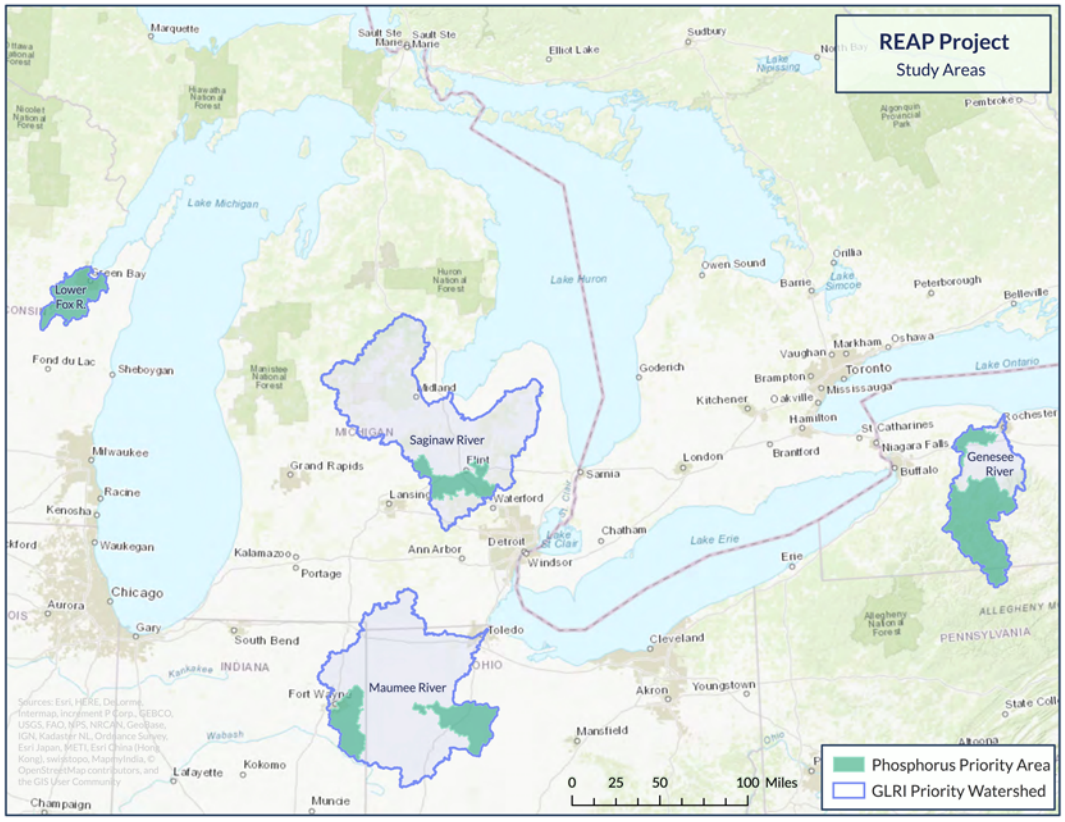


(3) *What is the impact of GLRI programs on key drivers of adoption (e.g., risk perception, confidence, etc.?)* Comparisons between GLRI and other sources is difficult as 20% of farmers who answered the question about GLRI participation were unsure if they participated in a GLRI-funded project or program. GLRI appears to be similar in impact to other federal funded programs (such as NRCS programs funded through the Farm Bill). However, GLRI participants did perceive cost barriers as slightly lower than participants in other government programs. While there is no clear evidence that GLRI participants hold any specific beliefs more strongly than participants in other federal programs (i.e., responsibility, practice effectiveness, concern about nutrient loss, etc), there is evidence that these beliefs are greatest among those participating in both GLRI *and* other government programs. Put another way, GLRI participants may be the most conscientious and concerned about nutrient loss, and therefore seeking out multiple opportunities to participate in conservation.

Survey Instrument and Methodology

In early 2019, a survey was sent to 3500 farmers in the Saginaw watershed in Michigan; the Maumee watershed in Ohio, Indiana, and Michigan; the Lower Fox watershed in Wisconsin; and the Genesee watershed in New York (Fig. 2). The sample of farmers was stratified by county to represent even numbers in all counties intersecting the four priority watersheds. The mixed mode survey was delivered via the mail with an option to complete it online. The mailed implementation process used the Tailored Design Method (Dillman, 2000). A total of 616 responses were used out of 2830 valid possible respondents with an adjusted response rate of 22% and 9% adjusted rejection rate. 40% of responses were from farmers in the Maumee watershed, followed by 25% in the Genesee and 24% in the Lower Fox. Only 11% of responses came from farmers in the Saginaw watershed. For more information on the analyses in this report[1], and the limitations of the data[2], see the executive summary endnotes.

Figure 3. The Four EPA Priority Watersheds



Key Findings

Section 1: Priority Watershed Comparisons

- **Farmers in the GLRI priority watersheds (here on out, GLRI farmers) are older than national averages.** The average farmer is 60 years old with 35 years of experience. This is important when considering that younger farmers are more conservation oriented, but most farm decision makers are older. One-third of farmers are also unsure of their succession plan, indicating that there is uncertainty regarding the future of the farm after they retire. The majority of GLRI farmers have net farm income under $50K, receive off-farm income, and operate on less than 250 acres (with farms trending larger in the Genesee and smaller in the Saginaw).

- **The majority of GLRI farmers manage some rented land.** Managing rented land is less common in the Saginaw (45% rent some land vs. 60-70% in the other priority watersheds). While conservation decisions are made primarily by the operator, 20 to 40% report making decisions with their landlord (most commonly in the Maumee). While most farmers rent from a family member or friend, the confidence in their ability to rent that land varies, with farmers in the Lower Fox being the least confident and farmers in the Maumee and Saginaw being the most confident.

- **Conservation practices are widespread but variable across the watersheds.** Farmers in the Saginaw and Lower Fox report the greatest use of conventional tillage, farmers in the Genesee report the greatest use of conservation tillage, and Maumee farmers report the greatest use of no-till. Most famers indicate the use of a crop rotation (e.g., corn/soy), but more diverse rotations are most common in the Genesee and Lower Fox (e.g., corn/soy with forage). The Lower Fox had the highest proportion of farmers with a nutrient management plan compared to the other watersheds (~70% versus 45%), while full implementation of the plan varies from a low of 65% in the Maumee and Saginaw, to 80+% in the Genesee and Lower Fox.

- **GLRI farmers are most concerned about making a profit.** Other top concerns include managing soil health and passing on the farm to the next generation. Overall, farmers in the Maumee report greater concern about a number of issues including passing on their farm, the management decisions of others, government regulation, lawsuits, and nutrient loss from agriculture in general and from their own farm. Farmers in the Genesee consistently have the lowest levels of concern about the issues identified above.

- **GLRI farmers are not convinced that agriculture is the main driver of algal blooms.** While overall GLRI farmers believe that agriculture is not the main driver, this belief was found to be strongest among farmers in the Maumee.

- **GLRI farmers are generally well informed about conservation practices.** However, farmers in the Saginaw report being generally less informed about conservation practices, particularly in comparison to those in the Lower Fox.

- **GLRI farmers believe it is more their responsibility than the government to protect the watershed**. This points to the challenge of fully engaging farmers in government programs, as GLRI farmers tend to be willing to change their practices but do not believe it is the government's responsibility to protect water quality (perhaps reflecting a general dislike for government intervention in private decisions).

- **GLRI farmers believe they know what to do and that conservation practices can "work".** However, there is considerable variability in these responses. For example, farmers in the Saginaw strongly believe that widespread adoption of cover crops can improve water quality, while farmers in the Genesee strongly believe in the on-farm benefits of cover crops, but less so in the water quality benefits. These beliefs are critical, as believing less in the benefits of the practices has a negative impact on adoption. GLRI farmers also believe that the practices needed are unique to each farm, pointing to the need to move away from "one size fits all" approaches to conservation.

- **GLRI farmers share a strong conservation identity.** GLRI farmers share similar levels of conservation and production identities, with conservation identities typically being stronger than production identities. Farmers believed the most important trait of a good farmer is leaving the land in better condition than when they received it, followed by minimizing soil erosion and maintaining organic matter. Given these results, differences in adoption between watersheds are unlikely to be a result of differences in conservationist identity or a commitment to "land stewardship" because these sentiments are pervasive and uniform.

- **GLRI farmers share a similar high reliance on other farmers and local conservation districts.** GLRI farmers didn't generally indicate a need for more information, but they did report a reliance on local "boots on the ground" and one-on-one feedback from other local farmers, conservation districts, crop advisors, and fertilizer applicators. They rely the least on commodity groups, Farm Bureau, and local conservation groups. Farmers in the Maumee rely more on fertilizer applicators, family members, and Farm Bureau than farmers in the other priority watersheds, while farmers in the Lower Fox rely more on crop advisors than everyone else. Preferred sources of information include conservation districts, demo farms, University Extension, other farmers, and direct on-farm feedback.

- **Cover crop use is higher in the GLRI watersheds than the rest of the Great Lakes[1].** The majority of GLRI farmers also plan to continue cover crops but are unlikely to do so without

[1] Recent USDA estimates estimate that cover crops are planted on less than 5% of the total acreage in the corn belt and the Lake states (see https://www.usda.gov/oce/oeep/USDA_Conservation_Trends.pdf), while our survey data indicates that 55% of GLRI farmers are using cover crops on at least 50% of their acreage (or ~25% of the total acreage described in the survey).

incentives. Adoption is higher in the Genesee compared to the other priority watersheds, but even in the Genesee only a minority have implemented cover crops on the majority of their acres. Farmers rated most cover crop implementation barriers as only limiting their ability a little bit. However, the specific importance of each barrier varied for each watershed, with Maumee farmers generally perceiving most barriers as more limiting than farmers in the Genesee. Challenges with uncertainty in the weather, access to equipment, the time it takes to manage, and the lack of an immediate economic return were consistently some of the highest perceived barriers across all watersheds.

- **Vegetated buffer use is high among GLRI farmers.** The majority of GLRI farmers plan to continue the same amount of buffer use, but they are unlikely to do so without incentives and the majority in each watershed have less than 50% of their acres draining into a buffer. The biggest perceived barriers to buffer use include losing land, weather uncertainty, lack of an economic return, and program restrictions. The importance of different barriers to buffer use varies less by watershed compared to cover crops. However, similarly to cover crops, the majority of barriers that farmers rated were, on average, rated as not limiting their ability to use buffers or only limiting it a little bit.

- **Future government program participation is uncertain:** 15-20% of farmers in each priority watershed are unsure if they participate in GLRI-funded programs, which indicates a need for greater awareness of the source of incentive payments for farmers receiving federal assistance. In addition, 15-20% will not participate in government programs in the future, and 40% are unsure, indicating farmers are not convinced that current programs are the solution. Paperwork and management restrictions are perceived as the biggest barriers to program participation, while information availability and program length are the smallest barriers. Generally, farmers in the Saginaw perceive the barriers as less problematic than farmers in the other priority watersheds. In particular, they are less concerned about restrictions on how land in programs is managed, payment size, and program length.

Section 2: Comparisons of information sources, perceived barriers, and key beliefs by farm size, practice adoption and program participation

- **Reliance on different sources for guidance is similar across all farm size categories.** Overall, farmers rely least on local conservation groups, Farm Bureau, and commodity groups, but reliance on direct feedback of practice effectiveness (i.e., edge of field measures of nutrient loss) and NRCS increases with farm size. This trend based on farm size could be more about having more access to these types of sources as opposed to just relying on them more. Farmers over the age of 80 consistently rely on each source of guidance less than younger farmers and are particularly less likely to rely on direct feedback on practice effectiveness but more likely to rely on county extension agents. Farmers under the age of 40 are most likely to rely on family as a source of guidance.

- **GLRI farmers generally believe that payments associated with government programs are too small, rather than too slow**. Farmers enrolled in government programs in general (not GLRI specifically) were less likely to think that program payments were too slow, while on average, those not participating in programs believed that payments were to slow. This may point to a misconception that farmers hold about payment speed before enrolling in a program. Perceived cost barriers are similar across different farm size categories.

- **Concern about soil health and farm succession is high regardless of practice use and program participation.** However, overall concern about soil health is lower for those not using cover crops (and slightly lower for those not using buffers), indicating that concern about soil health is a likely driver of cover crop use. Also, a greater proportion of participants in government programs indicate high levels of concern about soil health and farm succession compared to farmers who do not participate in government programs. There is no evidence that participants in GLRI programs are more concerned about these issues than participants in other government conservation programs, although the greatest proportion of individuals with high concern for soil health were those participating in both GLRI and other government programs.

- **Beliefs about personal responsibility for watershed health, degree of conservation knowledge, and one's action having an impact are greater among those already engaged in conservation.** This pattern could mean that holding such beliefs leads to adoption, or that having used a practice changes one's beliefs (the latter being particularly true for knowledge, which one could imagine increases with experience). While there is no clear evidence that GLRI participants hold these beliefs more strongly than participants in other programs, these beliefs are greatest among those participating in both GLRI *and* other government programs. Concern about nutrient loss from agriculture in general may be a greater driver for participation in programs in general while concern about one's *own* farm may drive participation in GLRI. In summary, GLRI participants may be the most conscientious and concerned about nutrient loss, and therefore seeking multiple opportunities to participate in conservation programs.

- **Vegetative buffer and cover crop use is strongly associated with higher levels of knowledge, greater exposure to the practice on a similar farm, less uncertainty of the benefits, and beliefs about effectiveness.** In particular, farmers using cover crops and buffers are much more likely to report not being limited at all, and much less likely to report being limited some or a lot by these three barriers. Farmers using these practices are also more likely to believe that they can reduce nutrient loss and improve water quality. Farmers with larger operations are more likely to perceive their use of cover crops as limited by the weather, while smaller operations are more limited by knowledge. Similarly, those with smaller operations (compared to larger operations) feel more limited by knowledge, equipment access and seeing the practice elsewhere for buffers.

- **Farmers with smaller operations report having less ability to implement conservation practices and less access to programs.** These limitations have to do with a lack of knowledge, access to equipment, and not seeing the practice on a farm like theirs. Conversely, larger farms reportedly perceive uncertainty in the weather and time as more significant barriers when implementing cover crops. Lack of knowledge applies to both cover crop and buffer use for smaller farms, while a lack of equipment and demonstrations are a bigger challenge for buffers. Interest in government programs also increases with farm size. While interest is greater on larger farms, these farms (the biggest farms in particular) report being more limited by restrictions on how land in programs is managed and a lack of flexibility to meet their own farming needs.

- **The percent of cover crop and vegetative buffer use increases as the percentage of rented acres decreases**. The majority of cover crop and vegetative buffer users fall in the category of less than 25% rented acres. Less than ten percent of those who rent 75-100% of their acres are currently using cover crops or vegetative buffers. This reveals a gap in engagement or flexibility for renters to adopt cover crops and vegetative buffers.

- **Sole decision-making authority is highest for those in the 40-60 year old age range, and lowest for both those under 40 and over 80.** A greater tendency for those under 40 to be making decisions in consultation with their landlord, and those on the largest farms (greater than 1500 acres) to be making decisions in consultation with a landlord was also reported.

Section 3: Explaining cover crop and buffer use and program participation

- **Interest in program participation increases among farmers who are younger, more educated, and believe more in practice effectiveness.** Several barriers decreased the odds of an interested farmer participating in government conservation programs. These were related to program structure (i.e., information access, flexibility, restrictions), and not related to payment structure. Smaller farms were unlikely to participate in programs unless they reported extremely high interest, pointing to the fact that programs may not be catering to smaller farms.

- **Specific practice use is driven largely by a belief that the benefits are certain and the practice is effective.** Cover crop use is also greater among younger farmers and on larger farms, while buffers are more common on larger farms. Beliefs about the benefits and effectiveness of both practices are greatest for those who strongly identify as a conservationist. Farmers with strong conservation identities are more likely to be female, younger, with less generations farming and livestock. However, identities don't vary by watershed or farm size. For cover crops, those with more formal education and a greater sense of responsibility for downstream water quality perceive practices as more effective. Larger farms are also more certain about the benefits of cover crops. For buffers, those who believe the government should protect downstream water quality are more uncertain about the benefits. Those who feel a greater sense of personal responsibility for overall

watershed health and who believe their on-farm actions have an impact on water quality believe more in buffer effectiveness.

Summary and Recommendations

The following recommendations are designed to increase the impact of government investments in conservation as well as increase future adoption of conservation practices. These recommendations might be useful to individuals across the public and private sector who are engaging farmers in conservation programs. The key findings are called out in italics below, followed by recommendations that build on them.

- *To address the fact that the majority of GLRI farms are small and small farms* face *greater barriers to conservation program participation compared to larger farms, including limited access to equipment,* GLRI investments should support the purchase of conservation-oriented farming equipment for community use. Future efforts could also work to build interest in government programs, as strong interest overcomes small farm size. Interest can be built by increasing access to information and program flexibility, decreasing program restrictions, giving voice to younger farmers who may not hold decision-making power, and measuring and communicating the benefits of conservation use more clearly. Existing programs should also increase efforts to target younger farmers and larger farms as interest in conservation and related incentive programs is already high among these groups.

- *To address the reality that the majority of farmers manage rented land and a plurality make conservation decisions with their landlords*, future efforts should work to engage landowners and increase the number of written leases with conservation requirements. Large-scale success in conservation will require thinking more critically about how to support conservation on rented land.

- *To increase the critical beliefs around practice benefits and effectiveness*, future efforts should focus on demonstration opportunities and increasing understanding about practices and their benefits, particularly those related to soil health and economic returns. The knowledge gap is greater around believing that practices will work versus knowing what to do. Decreasing this gap is likely to lead to greater practice adoption.

- *To accommodate the belief that each farm is unique and overcome the perception that agriculture is not the main driver of water quality challenges,* future efforts should find ways to tailor recommendations to each individual farm through personalized technical support (increased funding for more "boots on the ground"). Increased use of decision support tools can also allow for personalized recommendations to be scaled up without increasing technical support personnel. Future outreach should also provide evidence of agriculture's impact on water quality, while highlighting the actions that have been taken to address other drivers of water quality impairment (e.g. septic systems, urban stormwater). Recognizing the collaborative efforts across urban and rural landscapes should decrease resistance based on this belief.

- *To address farmers primary concerns*, frame the need for conservation around issues of profit and soil health (not nutrient loss per se). Future engagement should focus on how conservation can alleviate the most pressing concerns. For example, demonstrate how recommended conservation practices can improve soil health, reduce the money spent on inputs, and prevent soil erosion. Increasing concern about soil health may also drive participation in programs and practice adoption. Maumee farmers are particularly concerned about regulation and lawsuits, so future investments in that watershed should explore options for protecting farmers from lawsuits and/or regulatory penalties given active conservation.

- *To leverage the fact that farmers rely on other farmers for guidance and want more direct feedback and demonstrations*, future funding should focus on direct outreach and engagement as well as highlighting successes on a variety of farms. Conservation professionals should look for local champions and fund demonstration events in critical counties so that other farmers can explain and demonstrate the benefits of conservation. These peer-to-peer learning opportunities need to be to set up on properties of multiple sizes and for different types of farmers to better to represent the entire diversity of the agricultural community (not just the conservation-minded individuals). Outreach professionals should consider that larger farm categories may have more resources to seek guidance, and that older farmers are least likely to seek guidance from intermediaries or direct feedback.

- *To leverage farmers' strong conservation identity*, future engagement should promote how conservation allows farmers to leave the land in better condition than when they began managing it. People tend to engage in more conservation when thinking about their legacy; future outreach can highlight that farmers are the backbone of America, and that improving the land is critical to leaving a lasting legacy. Generally, there is a need to continue to promote a culture of conservation as conservation-minded farmers have greater confidence in recommended practices and higher levels of practice adoption, yet may have less experience and be the younger operator in a farm partnership.

- *To promote greater cover crop and buffer use*, future investments should include contracts for the installation of cover crops across multiple years to allow on-farm (economic) benefits to be realized, while finding ways to increase acres in cover crops on farms already using the practice. Cover crop knowledge was also highest in locations where adoption rates were higher, pointing to the importance of trialing the practice to address knowledge gaps. As a result, future programs should promote experimenting with cover crops at a small scale, using a single species, perhaps with a more experienced farm partner as a sounding board to help new users gain experience (particularly important in the Maumee). For buffers, future programs should decrease restrictions on how that land is managed (this is less of an issue in the Saginaw), while finding ways to increase acres draining through a buffer on farms where buffers already exist.

- *To increase participation in government programs*, programs need to be more flexible, with less paperwork and restrictions. Increasing a sense of personal responsibility, concern about soil health, and the belief that on-farm actions impact the entire watershed may increase participation in programs (as well as adoption of conservation practices in general). To address the fact that many are unsure about participating in government programs and reluctant to give responsibility to the government, future efforts should identify ways to empower farmers to engage in conservation without government assistance.

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[1] We conducted the statistical analyses included in this report using the Statistical Program for the Social Sciences (SPSS). To compare how priority watersheds differ by a variety of metrics, we analyzed frequency distributions, measures of central tendency (mean, medium, mode) and valid percentages. We derived the valid percentages from case-by-case deletion of missing data for each variable analyzed. To address the comparative analyses explored in Section 2, we used cross tabulations and means tables to identify how average perceptions or behaviors differed by farm size, practice adoption, program participation, etc. To address the correlational analyses explored in Section 3, we used a linear regression model to determine what type of farmer in terms of beliefs and characteristics is interested in government-funded programs. Then, we used a moderated regression model to explore the effect of farm size and program participation barriers on the positive relationship between interest and program participation. Finally, we ran a mediated regression model to analyze the direct effect of characteristics like farm size and age on cover crop and vegetative buffer adoption, and the indirect effect through beliefs about practice effectiveness.

[2] While we designed to sample to target equal respondents in each watershed, the number of respondents varied across each watershed, with a very low number of responses from the Saginaw. We explored this possible non-response bias in a follow-up study to assess if there were differences in the populations being represented by this data based on location and relative response rate. We sent a follow-up survey to a random 500 non-respondents split evenly between watersheds. One month later, we sent a second wave of the surveys to a predetermined 125 respondents, split between watersheds. If a subject chosen to receive a reminder survey had already responded, we removed them from the mailing list. Of 47 returned surveys, 23 were responses, 6 were undeliverable, and 18 were no longer farming/deceased/not able to respond.

The follow-up survey consisted of a condensed version of the original survey (Appendix B). We conducted two types of analyses to determine if participants in the original study were systematically different in some way from those who did not participate. The first analysis compared the 23 non-respondents with the first 250 respondents from the original data collection. The second analysis compared the first 250 respondents to the last 80 respondents from the original data collection (where late responders serve as a proxy for non-responders). We ran a series of binary logistic and multinomial regressions for each variable to determine if a significant difference existed between groups. The significant differences are bulleted below. **Findings suggest there is no clear non-response bias due to mixed results and the fact that most measures did not differ between groups.**

- Respondents (versus non-respondents) are more likely to have a nutrient management plan for their farm, less likely to think a good farmer minimized nutrient runoff, and more likely to think agriculture is not the main driver of algal blooms.
- We found no differences between respondents and non-respondents on the following items: perceived responsibility, response-efficacy, willingness to change practices, extent of feeling informed, availability of government programs, extent of restrictions on how land in programs is managed, current cover crop and vegetative buffer use, livestock management, size of farm

operation, proportion acres rented, years farmed, off-farm income, participation in GLRI program, and participation in other government-funded programs for conservation.

Section 1: Priority Watershed Comparison

Farmer concern for the farm and community

To investigate how levels of concern for the farm and community may differ by watershed, respondents were asked to circle a number between 0 (not concerned) and 6 (extremely concerned). Table 2 displays the average level of concern for each item by watershed, loosely ordered from most to least concerning. Across all items, **the highest concern in each watershed was for making an annual profit**. Generally, **farmers were the most concerned about making an annual profit, managing soil health on their farm, and passing their farms on to the next generation.** They also had higher concern about the impacts of agricultural nutrient loss on the watershed compared to nutrient loss on their own farm.

An ANOVA with post hoc tests determined whether differences in concern between watersheds existed. Items where concern is statistically different between two or more watersheds are bolded. In cases where the differences extend beyond two watersheds, the mean or means that are different from the others are indicated with an asterisk. **Overall, farmers in the Maumee have statistically higher concern for many issues.** Maumee farmers have higher concern for passing their farm on compared to the Lower Fox; management decisions of other farmers compared to the Genesee; government regulation compared to the Saginaw and Genesee; lawsuits compared to the Saginaw and Genesee; nutrient loss from agriculture compared to the Genesee; and nutrient loss from one's farm compared to the Saginaw and Genesee. Farmers in the Genesee often report the lowest levels of concern across the board, while farmers in the Lower Fox (similar to the Maumee) report greater concern about nutrient loss from agriculture and one's own farm compared to the Genesee, and Saginaw in some cases.

Table 2. Average level of concern for farm and community challenges (scale: 0 = not concerned, 6 = extremely concerned)

	Genesee N~154	**Lower Fox** N~144	**Maumee** N~ 237	**Saginaw** N~ 65
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Making annual profit	5.18 (1.35)	5.33 (1.01)	5.20 (1.21)	4.91 (1.45)
Managing soil health on your farm	4.84 (1.32)	4.77 (1.28)	4.94 (1.15)	4.54 (1.40)
Passing your farm on to the next generation	4.57 (1.85)	**4.18** (1.96)	**4.81** (1.64)	4.36 (1.76)
Management decisions of other farmers in your community	**3.73** (1.53)	4.01 (1.46)	**4.15** (1.47)	3.75 (1.61)
Additional government regulation or rules related to ag nutrient loss	**3.69** (1.88)	4.14 (1.63)	**4.27*** (1.76)	**3.49** (1.87)
Lawsuit filed against farmers because of nutrient loss	**3.67** (1.97)	4.13 (1.83)	**4.45*** (1.79)	**3.57** (1.94)
Nutrient loss from agriculture negatively impacting watershed	**3.18** (1.78)	**3.79*** (1.75)	**3.78*** (1.73)	3.45 (1.82)
Nutrient loss from your farm negatively impacting watershed	**2.16** (1.85)	**3.35*** (1.82)	**3.48*** (1.83)	**2.55** (2.00)

Farmer beliefs about nutrient management and conservation practices

Farmers were asked to indicate their level of agreement with statements representing beliefs about perceived responsibility for water quality, response efficacy (i.e., effectiveness of conservation practices), willingness to change, and awareness of water quality issues and conservation practices. Responses were recorded on a scale where strongly disagree = -2, disagree = -1, neither disagree nor agree = 0, agree = 1, and strongly agree = 2. Table 3 displays the average response and standard deviation for the belief items, loosely ordered from strongest agreement to strongest disagreement.

Overall, **farmers believe it is their responsibility help protect the watershed and disagree or only slightly agree that it is the responsibility of the government to protect the watershed.** On average, farmers in all watersheds would be willing to change their current practices to improve water quality, while all farmers agree to some extent that they know what steps to take to reduce nutrient loss on their farm. An ANOVA with post hoc tests determined whether differences in beliefs between watersheds existed. Items where concern is statistically different

between two or more watersheds are bolded. In cases where the differences extend beyond two watersheds, the mean or means that are different from the others are indicated with an asterisk. Farmers in the Maumee are more convinced that agriculture is not the main driver of algal blooms compared to everyone else. Farmers in the Lower Fox are more likely to report being better informed about practices compared to farmers in the Saginaw, and farmers in the Lower Fox are more likely to believe that their quality of life depends on a healthy watershed compared to those in the Genesee.

Table 3. Average beliefs regarding farmer responsibility, knowledge, etc. (scale: -2 = strongly disagree, 2 = strongly agree)

	Genesee N~ 154	**Lower Fox** N~ 145	**Maumee** N~ 240	**Saginaw** N~ 67
	Mean (SD)	Mean (SD)	Mean(SD)	Mean (SD)
It is the responsibility of farmers to help protect watershed	.86 (.80)	.77 (.80)	.79 (.86)	1.04 (.68)
Agriculture is not the main driver of algal blooms in watershed	**.45** (.87)	**.37** (.87)	**.72*** (1.00)	**.09** (.89)
I think I am better informed about conservation practices than most farmers	.37 (.93)	**.49** (.93)	.37 (.82)	**.13** (.95)
The quality of life in my community depends on healthy watershed	**.04** (1.04)	**.37** (1.04)	.16 (1.01)	.30 (1.06)
It is the responsibility of the government to protect watershed	.06 (.98)	-.01 (.98)	-.05 (1.05)	.22 (.93)
I am not willing to change my current practices to improve water quality	-.51 (1.01)	-.48 (1.01)	-.45 (1.08)	-.74 (.87)
I am unsure of what steps to take to reduce nutrient loss on my farm	-.52 (1.01)	-.51 (1.01)	-.32 (.97)	-.55 (.86)

Table 4 continues the list of beliefs, with greater focus on farmer beliefs in the effectiveness of several specific practices typically funded by GLRI. Responses were again recorded on a scale from strongly disagree = -2 to strongly agree = 2 (where neither disagree nor agree = 0). Table 4

displays the average response and standard deviation for the belief items, loosely ordered from strongest agreement to strongest disagreement.

Farmers across all watersheds agreed that practices that benefit water quality also benefit their farm and that cover crops/buffers can reduce nutrient loss on their farm. Farmers across all watersheds also agreed that widespread adoption of such practices can improve water quality in the watershed (i.e., high response efficacy). Farmers in each watershed also agreed that the practices needed to reduce nutrient loss are unique to each farm.

An ANOVA with post hoc tests determined whether differences in beliefs between watersheds existed. Items where concern is statistically different between two or more watersheds are bolded. In cases where the differences extend beyond two watersheds, the mean or means that are different from the others are indicated with an asterisk. Farmers in the Saginaw believe more than farmers in the Maumee that the widespread adoption of cover crops can improve water quality. Farmers in the Genesee agree more than farmers in the Maumee that cover crops can reduce nutrient loss on their farm but disagree more than Maumee and Lower Fox farmers that their actions on their farm can have measurable impact on the watershed.

Table 4. Beliefs about practice efficacy (scale: -2 = strongly disagree, 2 = strongly agree)

	Genesee N~ 154	**Lower Fox** N~ 145	**Maumee** N~ 240	**Saginaw** N~ 67
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Practices that benefit water quality also benefit my farm	1.02 (.87)	.93 (.84)	.84 (.87)	.85 (.76)
The practices needed to reduce nutrient loss are unique to each farm	.88 (.82)	.90 (.77)	.90 (.71)	.75 (.84)
Widespread adoption of grass buffers can improve water quality in watershed	.82 (.76)	.67 (.96)	.80 (.91)	.97 (.88)
Widespread adoption of cover crops can improve water quality in watershed	.79 (.72)	.66 (.85)	**.59** (.92)	**.91** (.69)
My actions on my farm have a measurable impact on the watershed	**-.34*** (1.17)	**.10** (1.10)	**.16** (1.12)	.07 (1.26)
Grass buffers can reduce nutrient loss on my farm	.61 (.96)	.57 (.88)	.61 (1.01)	.66 (1.00)
Cover crops can reduce nutrient loss on my farm	**.93** (1.14)	.70 (1.07)	**.62** (1.16)	.94 (.96)

Cover crop use and perceived barriers to implementation

Farmers in the Genesee have the highest adoption rate of cover crops (Table 5). On average, **farmers in the Genesee and Saginaw have implemented cover crops for longer than farmers in the Lower Fox and Maumee** (Table 6).

Table 5. Percentage of respondents currently using cover crops

	Genesee N=153	**Lower Fox** N=144	**Maumee** N=242	**Saginaw** N=67
Currently using cover crops	68.6%	54.9%	45.0%	52.2%

Table 6. Average years of cover crop implementation

	Genesee N=91	**Lower Fox** N=67	**Maumee** N=100	**Saginaw** N=30
Years using cover crops	15.6	8.4	8.6	14.4

In terms of coverage by acres (Table 7), **farmers in the Lower Fox have the lowest coverage on average. Approximately 1/3 of farmers in the Genesee, Maumee, and Saginaw report greater than 50% of their acreage in cover crops**. In terms of future intentions (Table 8), the majority of farmers plan to "do the same", while no farmers in the Genesee and Saginaw indicated that they would "do less". The Lower Fox had the highest proportion of farmers who plan to "do more" in the future.

Table 7. Percent of respondents in each category of acres in cover crops

% total farm acres	**Genesee** N=107	**Lower Fox** N=81	**Maumee** N=122	**Saginaw** N=38
0-25%	24.3%	48.1%	37.7%	36.8%
25-50%	39.3%	28.4%	23.0%	23.7%
50-75%	19.6%	12.3%	17.2%	18.4%
75-100%	16.8%	11.1%	22.1%	21.1%

Table 8. Future cover crop intentions

Plans for using cover crops next year	**Genesee** N=152	**Lower Fox** N=141	**Maumee** N=236	**Saginaw** N=66
Do less	-	3.5%	1.7%	-
Do the same	74.3%	59.6%	72.9%	68.2%
Do more	25.7%	36.9%	25.4%	31.8%

Table 9 displays the average response for the question, "how likely are you to use cover crops in the future without incentives?" Responses were scaled from 1-4 including where 1 = will not use, 2 = unlikely to use, 3 = likely to use, and 4 = will definitely use. With average values less than three in each watershed, farmers are slightly unlikely to use cover crops in the future without incentives.

Table 9. Likelihood of future cover crop use without incentives (scale: 1 = will not use, 4 = definitely will use)

	Genesee N=153	**Lower Fox** N=141	**Maumee** N=237	**Saginaw** N=67
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Likelihood of future use without incentives	2.99 (.75)	2.65 (.80)	2.57 (.80)	2.79 (.77)

Respondents were asked to indicate how much the following barriers limited their ability to implement cover crops (Table 10). Barriers to implementation were listed on a scale where 0 = not at all, 1 = a little, 2 = some, and 3 = a lot, with the barriers loosely listed from biggest to smallest in the table below. **Challenges with access to equipment, the time it takes to manage, uncertainty in the weather, and the lack of an immediate economic return were consistently some of the highest perceived barriers across all watersheds. However, the majority of barriers that farmers rated were, on average, rated as not limiting their ability to use cover crops, or only limiting it a little bit.**

An ANOVA with post hoc tests determined whether differences in barriers between watersheds existed. Items where concern is statistically different between two or more watersheds are bolded. In cases where the differences extend beyond two watersheds, the mean or means that are different from the others are indicated with an asterisk. Across the board, **farmers in the Maumee perceive barriers to cover crop implementation as more limiting than farmers in the Genesee.** Time, technical assistance, and rented ground barriers are higher among farmers in the Maumee compared to those in the Genesee. The contract duration barrier is higher for

Maumee farmers than for Genesee and Saginaw farmers. The lack of demonstration barriers is higher for farmers in the Maumee and Saginaw. The restriction and changes of daily operation barriers are higher for farmers in the Maumee and Lower Fox compared to those in the Genesee. Uncertainty in the weather is a stronger barrier for farmers in the Maumee and Lower Fox compared to Saginaw farmers. The lack of immediate economic return is a stronger barrier for both farmers in the Maumee and Lower Fox compared to those in the Genesee and Saginaw. Uncertainty about benefits is perceived as more of a barrier for farmers in all watersheds compared to Genesee.

Table 10. Cover crop implementation barriers (scale: 0 = not at all, 3 = a lot)

	Genesee N~ 149	**Lower Fox** N~ 141	**Maumee** N~ 233	**Saginaw** N~ 65
The following barriers limit my ability to implement CCs	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Uncertainty in the weather	1.51 (1.05)	**1.66*** (1.11)	**1.63*** (1.08)	**1.12** (1.03)
Lack of right equipment	1.12 (1.05)	1.39 (1.14)	1.30 (1.09)	1.00 (1.07)
Too time consuming to manage	**.93** (.91)	1.06 (.91)	**1.22*** (.93)	1.00 (.91)
Lack of an immediate economic return	**.87** (.91)	**1.32*** (1.04)	**1.56*** (1.01)	**.91** (.92)
Too many restrictions associated with using the practice (e.g., not being able to harvest CCs)	**.68*** (.94)	**1.17** (1.08)	**1.20** (1.11)	.89 (1.02)
The contracts providing incentives are too short	**.73** (.94)	.98 (1.03)	**1.17*** (1.02)	**.79** (.99)
Requires too many changes in my daily operation	**.57*** (.81)	**.91** (.87)	**1.06** (.93)	.88 (.97)
Uncertainty about the benefits of this practice for my farm	**.44*** (.74)	**.87** (.89)	**1.06** (.99)	**.79** (.85)
Lack of knowledge about practice*	**.58** (.85)	.84 (.81)	**.97*** (.93)	.83 (.90)
Lack of technical assistance*	**.49** (.74)	.72 (.86)	**.73*** (.90)	.60 (.83)

Table 10. Continued	**Genesee** Mean (SD)	**Lower Fox** Mean (SD)	**Maumee** Mean (SD)	**Saginaw** Mean (SD)
Not being able to see demonstration on farm like mine*	**.41*** (.73)	.61 (.85)	**.68** (.92)	**.75** (1.03)
Not wanting to use the practice on rented ground*	**.37** (.78)	.63 (.85)	**.82*** (1.00)	.68 (.95)

Vegetative buffer use and perceived barriers to implementation

Table 11 displays the percentage of respondents currently using vegetative buffers on their farm. Farmers in the Lower Fox and Maumee have higher adoption rates than those in the Saginaw and Genesee. On average, **farmers across all four watersheds have used vegetative buffers longer than cover crops, with each average around 20 years** (Table 12).

Table 11. Percentage of respondents currently using vegetative buffers

	Genesee N=153	**Lower Fox** N=139	**Maumee** N=236	**Saginaw** N=67
Currently using vegetative buffers	52.3%	60.4%	59.3%	50.7%

Table 12. Average years of vegetative buffer implementation

	Genesee N=65	**Lower Fox** N=74	**Maumee** N=123	**Saginaw** N=28
Years of buffer use	23.3	20.2	17.72	21.75

Table 13 displays the percentage of farmers reporting different levels of acres draining into or across a vegetative buffer. Approximately 38% of farmers in the Saginaw had more than 50% of their acres draining into or across a vegetative buffer, while only 23% of farmers in the Maumee reported more than 50% of their acreage draining into a buffer. In terms of future intentions (Table 14), more farmers in the Lower Fox and Maumee indicated they would "do less" for future vegetative buffer implementation than farmers in the Saginaw and Genesee. As seen with cover crops, **the majority of farmers would "do the same" with future vegetative buffer implementation**. Lower Fox had the highest proportion of farmers planning to "do more" vegetative buffers next year.

Table 13. Percent respondents in each category of acreage draining into vegetative buffers

% total farm acres	**Genesee** N=98	**Lower Fox** N=94	**Maumee** N=159	**Saginaw** N=37
0-25%	52.0%	38.3%	47.2%	40.5%
25-50%	21.4%	29.8%	29.6%	21.6%
50-75%	9.2%	21.3%	14.5%	27.0%
75-100%	17.3%	10.6%	8.8%	10.8%

Table 14. Future vegetative buffer intentions

Plans for using buffers next year	**Genesee** N=56	**Lower Fox** N=42	**Maumee** N=84	**Saginaw** N=30
Do less	3.6%	7.1%	8.3%	3.3%
Do the same	66.1%	57.1%	66.7%	76.7%
Do more	30.4%	35.7%	25.0%	20.0%

Table 15 displays the average response for the question, "how likely are you to use vegetative buffers in the future without incentives?" Responses were scaled where 1 = will not use, 2= unlikely to use, 3 = likely to use, and 4 = will definitely use. With average values less than three in each watershed, **farmers are slightly unlikely to use vegetative buffers in the future without incentives.**

Table 15. Likelihood of future vegetative buffer use without incentives

	Genesee N=150	**Lower Fox** N=138	**Maumee** N=228	**Saginaw** N=67
Likelihood of future use without incentives	2.75	2.60	2.50	2.43

Farmers were asked to how much the following factors limited their ability to implement vegetative buffers (Table 16). Barriers to implementation were measured on a scale where 0 = not at all, 1 = a little, 2 = some, and 3 = a lot, with the barriers loosely listed from biggest to smallest in the table below. **Across all watersheds, the highest perceived barriers included not wanting to lose land for production, uncertainty in the weather, lack of an immediate economic return, and too many restrictions (e.g., buffers too wide). However, similar to cover**

crops, the majority of barriers that farmers rated were, on average, rated as not limiting their ability to use buffers, or only limiting it a little bit.

An ANOVA with post hoc tests determined whether differences in barriers between watersheds existed. Items where concern is statistically different between two or more watersheds are bolded. **Compared to cover crop barriers, perceptions of vegetative buffer barriers vary less by watershed.** Uncertainty in the weather is a greater barrier for farmers in the Lower Fox compared to those in the Maumee. The barrier of installing the practice on rented ground is stronger for farmers in the Maumee than for Genesee farmers.

Table 16. Vegetative buffers implementation barriers (scale: 0 = not at all, 3 = a lot)

	Genesee N~ 147	**Lower Fox** N~ 134	**Maumee** N~ 244	**Saginaw** N~ 63
The following barriers limit my ability to implement VBs	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Not wanting to lose land for production	1.11 (1.13)	1.41 (1.10)	1.25 (1.16)	1.22 (1.13)
Too many restrictions (e.g., buffers too wide)	1.11 (1.03)	1.40 (1.06)	1.19 (1.10)	1.00 (.98)
Uncertainty in the weather	.93 (1.07)	**1.20** (1.11)	**.86** (1.05)	.79 (.99)
Lack of an immediate economic return	.92 (1.03)	1.20 (1.11)	1.13 (1.10)	.95 (.93)
The contracts providing incentives are too short	.88 (1.02)	.98 (1.01)	.93 (1.08)	.94 (1.04)
Too time consuming to manage	.84 (.84)	.92 (.85)	.89 (.97)	.84 (.89)
Lack of right equipment	.93 (1.10)	.87 (1.01)	.80 (1.01)	.71 (1.01)
Uncertainty about benefits of this practice for my farm	.76 (.95)	.82 (.90)	.83 (1.06)	.84 (.94)
Not wanting to use the practice on rented ground	**.58** (.92)	.86 (1.01)	**.89** (1.09)	.77 (1.02)

Table 16. Continued	**Genesee** Mean (SD)	**Lower Fox** Mean (SD)	**Maumee** Mean (SD)	**Saginaw** Mean (SD)
Lack of knowledge about practice	.75 (1.00)	.60 (.80)	.71 (1.01)	.83 (.95)
Requires too many changes in my daily operation	.64 (.80)	.69 (.83)	.65 (.91)	.66 (.86)
Lack of technical assistance	.58 (.78)	.56 (.79)	.60 (.92)	.81 (.96)
Not being able to see demonstration on farm like mine	.57 (.90)	.49 (.74)	.57 (.93)	.72 (.97)

Farmer identity and guidance source preference

The following items (Table 17) were adapted to represent how farmers may identify themselves as "productivist" or "conservationist" in their role as a farmer (Arbuckle, 2013; McGuire et al., 2015). The first six items relate to farmers who are conservationist-oriented, while the latter five items are associated with productivist-oriented farmers. Respondents were asked to indicate on a scale of 0-4 how important each item is to their definition of a good farmer, where 0 = not at all important, 1= slightly important, 2= somewhat important, 3= important, and 4= very important. The items are listed below in loose order from most to least important to their identity as a farmer.

On average, **farmers across all watersheds rank conservationist-oriented prompts with higher importance than the productivist-oriented prompts**. Among the productivist-oriented items, farmers across all watersheds identified more with having the highest yields per acre and highest profit per acre, when compared to getting their crops planted first or having the most up-to-date equipment. **The strongest sentiment among conservationist-oriented items was that a good farmer minimizes soil erosion.**

An ANOVA with post hoc tests determined whether differences in beliefs of what makes a good farmer existed between watersheds. Items where a statement is statistically different between two or more watersheds are in bold. **Across all statements regarding what makes a good farmer, perceptions were similar among watersheds** with one exception: farmers in the Saginaw believe it is more important than farmers in the Lower Fox that a good farmer has the most up to date equipment (productionist item).

Table 17. Farmer identity (scale: 0 = not at all important, 4 = very important)

	Genesee N~ 153	**Lower Fox** N~ 143	**Maumee** N~ 240	**Saginaw** N~ 66
A good farmer is one who…	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
minimizes soil erosion	3.17 (.80)	3.07 (.81)	3.09 (.91)	3.10 (.92)
maintains or increases soil organic matter	3.11 (.89)	2.88 (.94)	2.87 (1.02)	3.17 (.82)
manages for both profitability and minimization of environmental impact	3.08 (.81)	2.87 (.84)	2.94 (.94)	3.06 (.80)
minimizes nutrient runoff	2.86 (.98)	2.98 (.90)	2.90 (1.03)	3.01 (.90)
thinks beyond own farm to health of watershed	2.75 (.98)	2.82 (.92)	2.72 (1.05)	3.04 (1.07)
considers the health of waterways	2.67 (.96)	2.67 (.99)	2.67 (.99)	2.86 (.99)
has the highest profit per acre	2.41 (1.15)	2.35 (1.22)	2.38 (1.25)	2.29 (1.31)
has the highest yields per acre	1.97 (1.22)	1.83 (1.26)	2.10 (1.20)	2.17 (1.07)
uses latest seed and chemical technology	1.76 (1.14)	1.90 (1.23)	1.92 (1.25)	2.20 (1.23)
gets their crops planted first	1.14 (1.06)	.95 (1.13)	.97 (1.11)	1.18 (1.18)
has the most up to date equipment	.92 (1.00)	**.73** (.92)	.91 (1.11)	**1.23** (1.04)

The following items measured on the same 0 to 4 importance scale were not part of the original farmer identity scale but were added for this project to provide additional insight to the farmer decision making process (Table 18). The bolded items indicate which item responses are statistically different between watersheds. Farmers believed the most important trait of a good farmer is leaving the land in better condition, this was rated even higher than the top two items in the original identity scale (minimizing soil erosion and maintaining organic matter). Compared to those in the Maumee, Genesee farmers believe it is more important that a good farmer is one who adopts conservation practices despite challenges.

Table 18. Additional items included to capture what is important to farmer identities (scale: 0 = not at all important, 4 = very important)

	Genesee N~ 153	**Lower Fox** N~ 143	**Maumee** N~ 238	**Saginaw** N~ 67
A good farmer is one who…	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Leaves the land in a better condition than when they received it	3.35 (.77)	3.22 (.82)	3.30 (.83)	3.42 (.76)
Adopts conservation practices despite challenges	**2.74** (.86)	2.51 (.99)	**2.45** (1.06)	2.72 (.93)
Shares information about conservation with other farmers	2.52 (1.06)	2.48 (1.12)	2.46 (1.09)	2.64 (1.01)

Farmers were asked how much they rely on a list of sources for information when introducing and managing new conservation practices on their farm (Table 19). The level of reliance was measured on a scale where 0 = not at all, 1 = some, and 2 = a lot. The items are listed loosely in the table below from most relied upon to least relied upon.

Farmers across all watersheds rely the least on commodity groups, Farm Bureau, and local conservation groups – but share a similar high reliance on other farmers and local conservation districts. An ANOVA with post hoc tests determined whether differences in reliance between watersheds existed. Items where concern is statistically different between two or more watersheds are bolded. In cases where the differences extend beyond two watersheds, the mean or means that are different from the others are indicated with an asterisk. Farmers in the Maumee rely more on fertilizer applicators than those in the Genesee, and more on family members and Farm Bureau than those in the Lower Fox. However, Lower Fox farmers rely more on their crop advisor than farmers in all other watersheds.

Additionally, farmers were asked to indicate if they would like to receive more information from any of the following sources. **Few indicated that they wanted more info, but when they did there was interest in more information from county land conservation districts (N=37), demonstration farms (N=32), university extension (N=30,) direct feedback on their farm (N=29), and other local farmers (N=28).**

Table 19. Preferences for information and guidance sources (scale: 0 = not at all, 2 = a lot)

	Genesee N~ 148	**Lower Fox** N~ 141	**Maumee** N~ 232	**Saginaw** N~ 64
When adopting new conservation practices, how much do you rely on guidance from…	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Other local farmers	1.13 (.58)	1.07 (.54)	1.14 (.57)	1.03 (.64)
Your crop adviser/ consultant*	**1.01** (.81)	**1.27*** (.75)	**1.03** (.77)	**.83** (.79)
County land conservation districts	.99 (.68)	1.02 (.61)	1.12 (.68)	1.05 (.67)
Direct feedback e.g., edge of field	1.01 (.76)	.89 (.73)	1.05 (.68)	.88 (.75)
Your fertilizer applicator or retailer*	**.82** (.71)	1.01 (.69)	**1.20** (.70)	1.00 (.76)
Demonstration farms, field days, etc.	.85 (.60)	.96 (.60)	.96 (.64)	.89 (.69)
Family members*	.88 (.72)	**.71** (.61)	**.95** (.72)	.89 (.76)
University extension	.85 (.72)	.90 (.58)	.95 (.64)	.94 (.77)
Your county extension agent	.77 (.71)	.86 (.64)	.92 (.73)	.77 (.72)
NRCS	.83 (.73)	.90 (.75)	.88 (.75)	.75 (.74)
Local conservation groups	.48 (.62)	.66 (.66)	.61 (.64)	.58 (.56)
Farm Bureau*	.48 (.63)	**.42** (.58)	**.60** (.69)	.52 (.64)
Commodity groups	.35 (.57)	.43 (.53)	.44 (.60)	.42 (.64)

Government program participation and perceived barriers to participation

Table 20 identifies the percentage of farmers in each watershed who participate in or are unsure if they are participating in GLRI-funded programs. **About 15-20% of farmers in each watershed are unsure if they participate in GLRI-funded programs.** Farmers in the Genesee have the lowest GLRI participation rate, while farmers in the Lower Fox have the highest participation rate. Lower Fox farmers also had the highest percentage of farmers who were "unsure" about GLRI participation.

Table 20. Participating in GLRI Programs

Have you participated in GLRI-funded programs	**Genesee** N=153	**Lower Fox** N=142	**Maumee** N=237	**Saginaw** N=67
Yes	7.2%	17.6%	12.7%	9.0%
Unsure	15.0%	21.8%	17.3%	17.9%

Additionally, farmers were asked about their participation status in any government-funded program for conservation (e.g., CRP, EQIP, and CSP) (Table 21). **While participation rates are higher for programs in general than GLRI specifically, only one-third of farmers are enrolled in a government-funded program. T**he Maumee has the greatest amount of farmers enrolled in programs.

Table 21. Participation in government funded programs in general

Enrolled in any government-funded programs	**Genesee** N=150	**Lower Fox** N=133	**Maumee** N=228	**Saginaw** N=65
Yes	26.7%	29.3%	34.6%	16.9%

Table 22 displays the percentage of farmers in each watershed who would, would not or are unsure about their plans to enroll in programs in the future. **Less than 20% of farmers in each watershed indicated they would not participate in the future. However, emphasis should be placed on the observation that over 40% of farmers are unsure if they would participate in government-funded programs in the future.**

Table 22. Future intended participation in government funded programs

Continue to participate in government-funded programs in the future	**Genesee** N=150	**Lower Fox** N=133	**Maumee** N=228	**Saginaw** N=65
No	17.8%	13.5%	15.5%	18.6%
Yes	41.5%	39.7%	41.8%	27.1%
Unsure	40.7%	46.8%	42.7%	54.2%

Regardless of current or future program participation status, respondents were asked to what extent they agreed or disagreed with several statements about barriers to participation in government-incentive programs (Table 23). Responses were scaled from -2 strongly disagree to 2 strongly agree (where 0 = neither disagree nor agree), and the items are listed in the table below loosely from strongest agreement to strongest disagreement. **Farmers across all watersheds indicate some interest in program participation, while the greatest barriers are that there is too much paperwork required to participate and there are too many restrictions on how land in programs is managed. Farmers also report being more constrained by payment amounts than payment timeframe, structure, etc. Information availability and program length are relatively smaller barriers to most farmers.**

An ANOVA with post hoc tests was used to determine whether differences in barriers between watersheds existed. Items where concern is statistically different between two or more watersheds are bolded. In cases where the differences extend beyond two watersheds, the mean or means that are different from the others are indicated with an asterisk. **Generally, farmers in the Saginaw often perceive the barriers as less problematic than farmers in the other watersheds.** Specifically, restrictions on how land in programs is managed is more of a barrier for farmers in the Maumee and Genesee than those in the Saginaw. Payment size is more of a barrier for farmers in the Maumee than the Saginaw, and program length is more of a barrier for farmers in the Genesee than the Saginaw.

Table 23. Barriers to participation in government funded incentive programs (scale: -2 = strongly disagree, 2 = strongly agree)

	Genesee N=149	**Lower Fox** N=138	**Maumee** N=234	**Saginaw** N=63
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
There are too many restrictions on how land in programs is managed	**.62** (.91)	.57 (.85)	**.68** (.92)	**.26*** (.90)
There is too much paperwork required to participate	.55 (.91)	.41 (.87)	.52 (.91)	.32 (1.02)
The program payments are too small	.26 (.88)	.41 (.84)	**.43** (.87)	**.11** (.77)
I would prefer if payments were based on actual reductions in nutrient loss (e.g., pay for performance)	.15 (.88)	.25 (.79)	.19 (.81)	.16 (.68)
Program payments are too slow	.13 (.81)	.07 (.80)	.10 (.81)	-.14 (.80)
Programs are not flexible to meet the specific needs of my farm	.22 (.87)	.05 (.90)	.05 (.91)	-.02 (.92)
I would prefer if payments were higher to start but decreased over time	.11 (.76)	.10 (.83)	-.01 (.82)	-.11 (.70)
Information about government programs is not readily available	-.07 (.95)	-.26 (.90)	-.19 (.90)	-.21 (.90)
Programs are not long enough to allow the practice to start paying for itself	**-.01** (.73)	-.10 (.69)	-.12 (.75)	**-.30** (.53)
I am not interested in participating in government programs	-.35 (1.10)	-.24 (1.07)	-.34 (1.09)	-.22 (1.10)

Sample Demographics

The majority of farmers across all watersheds were identified as male, with the greatest proportion of females in the Genesee (Table 24). **The average farmer is about 60 years old** with average ages of 58, 59, 60, and 61 in the Genesee, Lower Fox, Maumee, and Saginaw, respectively.

Table 24. Gender

	Genesee N=152	**Lower Fox** N=143	**Maumee** N=242	**Saginaw** N=66
Male	85.5%	99.3%	94.6%	93.9%
Female	14.5%	.7%	5.4%	6.1%

Average educational attainment was scaled where 1 = some high school no diploma; 2 = high school degree or equivalent; 3 = some college, 4 = no degree; 5 = associates or bachelor's degree; and 6 = graduate or professional degree (Table 25). ***On average, farmers across each watershed have some college, but no degree, with farmers in the Lower Fox and Maumee having slightly less average educational attainment.***

Table 25. Education level

	Genesee N= 147	**Lower Fox** N= 142	**Maumee** N= 238	**Saginaw** N=63
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Education level	3.35 (1.18)	2.92 (1.02)	3.01 (1.15)	3.35 (1.21)

In terms of farming experience, **the average farmer has about 35 years of farming experience** (Table 26). In each watershed, about 50% of farmers identified as third-generation farmers. In addition, farmers were asked to describe their plans for retirement from options including: be operated by someone related to me, be operated by someone who is not related to me, be converted into non-farm use or have its development rights sold, be donated to a farmland preservation program, or unsure. **About half of farmers in each watershed indicated they would pass their farm on to a family member while approximately one-third or greater of farmers were unsure of their retirement plan.**

Table 26. Experience farming

	Genesee N=149	**Lower Fox** N=139	**Maumee** N=236	**Saginaw** N=64
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Years farmed	36.34 (16.19)	36.47 (14.65)	36.37 (16.09	35.23 (19.75)

Table 27 displays the percentage of farms in each net farm income bin and Table 28 displays percentage of farmers in each annual off-farm gross household income bin. A greater proportion of farmers in the Saginaw had net income levels below $50,000 than farmer in all of the other watersheds. The low sample size in the Saginaw should be taken into account when considering this. Table 29 displays the percentage of households who receive off farm income. **The Maumee and Saginaw which on average had lower median farm incomes, had higher percentages of farmers that received off-farm income.**

Table 27. Net farm income

	Genesee N= 146	**Lower Fox** N=131	**Maumee** N=222	**Saginaw** N = 61
< $50,000	48.6%	43.5%	54.5%	72.1%
$50,000 -$99,999	17.8%	23.7%	17.6%	14.8%
$100,000-$249,999	12.3%	14.5%	16.7%	9.8%
$250,000-$499,999	9.6%	10.7%	4.5%	1.6%
> $500,000	11.6%	7.6%	6.8%	1.6%

Table 28. Annual off-farm gross household income

	Genesee N= 103	**Lower Fox** N=90	**Maumee** N=184	**Saginaw** N = 59
< $10,000	7.8%	7.8%	5.4%	3.4%
$10,000 -$49,999	37.9%	38.9%	33.7%	33.9%
$50,000-$99,999	36.9%	34.4%	39.7%	42.4%
> $100,000	17.5%	18.9%	21.2%	20.3%

Table 29. Off-farm income

	Genesee		Lower Fox		Maumee		Saginaw	
	N	%	N	%	N	%	N	%
Off-farm income from farmer	124	60.5%	106	58.5%	192	78.6%	61	79.1%
Off-farm income from farmer spouse	131	64.9%	106	68.9%	185	76.8%	61	54.1%

Table 30 breaks down the farm size into four categories roughly based on USDA estimates for a small to medium to large family farm, and large non-family farm. **The majority of GLRI farms are also under 250 acres, with farms trending larger in the Genesee and smaller in the Saginaw.** The highest proportion of less than 250 acre farms was in the Saginaw, while the Genesee had the greatest proportion of farms 750 to 1500 acres. Table 31 displays the average proportion of rented acres per farm in each watershed, with the **lowest rented acreage in the Saginaw (16%) and the highest in the Lower Fox and Maumee (30%).**

Table 30. Farm size category

	Genesee N= 149	**Lower Fox** N=137	**Maumee** N=220	**Saginaw** N = 61
< 250 acres	36.9	46.0	48.6	73.8
250-750 acres	27.5	33.6	27.7	16.4
750-1500 acres	15.4	14.6	15.0	6.6
> 1500 acres	20.1	5.8	8.6	3.3

Table 31. Average proportion of acres rented per farm

	Genesee N= 155	**Lower Fox** N=141	**Maumee** N=239	**Saginaw** N= 67
% acres rented	24.4% (.18)	30.2% (.30)	30.0% (.31)	16.2% (.25)

Table 32 displays the median percent of planted acres in each tillage type this past year. Farmers in the Saginaw and Lower Fox report the greatest use of conventional tillage, while farmers in the Genesee report the greatest use of conservation tillage and Maumee farmers the greatest percent of no-till.

Table 32. Tillage type

	Genesee N= 155	**Lower Fox** N= 145	**Maumee** N= 245	**Saginaw** N=67
% planted acres for tillage type	Median	Median	Median	Median
Conventional (30% residue or less)	30%	50%	40%	50%
Conservation (30-90% residue)	50%	40%	30%	25%
No-till (90% residue or more)	23%	25%	50%	29%

The majority of famers in the Genesee, Lower Fox, Maumee and Saginaw have land in some rotation (approximately 80 to 90%) (Table 33). **More diverse rotations are more common in the Genesee and Lower Fox (i.e., other, with forage)**, than in the Maumee and Saginaw where the strong majority are corn/bean and corn/beans/wheat.

Table 33. Rotation type

Rotation Type	**Genesee** N=119	**Lower Fox** N=126	**Maumee** N=209	**Saginaw** N=53
Corn/beans	12.6%	27.0%	43.5%	34.0%
Corns/beans/wheat	30.3%	32.5%	44.0%	37.7%
Other with forage	33.6%	30.2%	7.2%	9.4%
Other	23.5%	10.3%	5.3%	18.9%

Table 34 displays the percentage of farmers with a current nutrient management plan for their farm. **The Lower Fox had the highest proportion of farmers with a nutrient management plan compared to the other watersheds (~70% versus 45%).** Approximately 80% of farmers in the Lower Fox indicated implementation on most (75-100%) of their farm, a number similar to implementation in the Genesee. Only 60-65% of farmers with a plan in the Maumee and Saginaw indicated they implemented their plan on most of their land.

Table 34. Percent of farmers with a plan and the acres on which they have it implemented

	Genesee N=148	**Lower Fox** N=141	**Maumee** N=233	**Saginaw** N=64
Current nutrient management plan	45.9%	68.8%	45.9%	45.3%
% farmers with plan implemented on "most (75-100%)" of their farm	80.9%	81.1%	61.5%	65.5%

In terms of rented acreage, approximately 67% of farmers in the Lower Fox managed at least some rented land, with about 60% of farmers in the Genesee and Maumee and 45% of farmers in the Saginaw. In terms of responsibility for conservation decisions, the majority of farmers make conservation decisions alone (Table 35). Farmers in the Maumee reported more frequently than other farmers that they with their landlord are primarily responsible for conservation decisions. On average, farmers across all watersheds have rented their largest plot of land for about 20 years.

Table 35. Responsibility for conservation decisions

Primarily responsible for conservation decisions	**Genesee** N=85	**Lower Fox** N=91	**Maumee** N=143	**Saginaw** N=29
Me alone	70.6%	71.4%	58.0%	62.1%
Me with landlord	24.7%	22.0%	37.1%	31.0%
Landlord alone	1.2%	5.5%	2.8%	3.4%
Other	3.5%	1.1%	2.1%	3.4%

Approximately 35% to 55% of farmers who rent some portion of their land have a formal written lease agreement (Table 36). The Genesee had the lowest percentage of conservation requirements included on the lease (31%), while the Saginaw had the highest (53%). Farmers also indicated how long they would be confident in their ability to keep renting their largest plot of land (Table 37). **Land tenure was most uncertain in the Lower Fox where the majority of farmers indicated they expected to rent their largest plot of land for less than five years, while the majority in the Lower Fox reported at least 3 years or more, and the majority in the Maumee and Saginaw reported more than five years.** Across all watersheds, the majority of farmers in the Genesee (60%), Lower Fox (60%), Maumee 75%), and Saginaw (72%) consider their landlord a friend or family member.

Table 36. Percent of farmers with written lease agreements and conservation requirements

	Genesee		Lower Fox		Maumee		Saginaw	
	N	%	N	%	N	%	N	%
Formal written lease agreement	102	54.9%	111	47.7%	165	35.2%	37	45.9%
Conservation requirement on lease	58	31.0%	55	47.3%	64	45.3%	15	53.3%

Table 37. Years confident in ability to keep renting largest plot

	Genesee N=94	Lower Fox N=99	Maumee N=152	Saginaw N=32
2 years or less	13.8%	21.2%	12.5%	9.4%
3-5 years	33.0%	40.4%	26.3%	31.3%
More than 5 years	53.2%	38.4%	61.2%	59.4%

Section 2: Cross Tabulations and Specific Comparisons

Farmer guidance sources varying by farm size and age

Farmers were asked to identify how much they relied on a list of sources for information when introducing and managing new conservation practices on their farm. Cross tabulations were performed to examine possible relationships between sources of guidance and farm and farmer characteristics such as farm size and age. The following tables contain farm size categories based on USDA averages of small family farms, medium family farms, large family farms, and industrial farms. The categories for farmer age are based on those under the 25th percentile, 26-50th percentile, 51-75th percentile, and greater than 75th percentile. The tables are displayed as heat maps where low percentages appear as yellow and high percentages appear as green.

Overall, reliance on guidance source is similar across all farm size categories (Table 38). **Farmers rely least on local conservation groups, Farm Bureau, and commodity groups. Reliance on direct feedback of practice effectiveness and NRCS increases with farm size.** This could reflect more about information access rather than reliance for large farms.

Farmers over the age of 80 consistently rely on each source of guidance less than younger farmers (Table 39). Farmers over the age of 80 are particularly less likely to rely on direct feedback on practice effectiveness than younger farmers. Although, a higher percentage of farmers over the age of 80 rely on county extension agents. **Farmers under the age of 40 are most likely to rely on family as a source of guidance than farmers in older age groups.**

Across all farm sizes and age groups, a high majority of farmers rely on other local farmers for guidance when introducing and managing new conservation practices on their farm. Interventions must support these existing social connections, particularly for younger farmers who more often rely on family as a source of guidance. Outreach professionals should consider that larger farm categories may have more resources to seek guidance, and that older farmers are least likely to seek guidance from intermediaries or direct feedback.

Table 38. Farmer guidance source by farm size

Guidance Source	**<250 Acres** N=272	**250-750 acres** N=158	**750-1500 acres** N=82	**>2500 acres** N=59
Other Local Farmers	87%	90%	88%	91%
County Land Conservation Districts	77%	84%	81%	85%
Demonstration Farms	71%	80%	81%	89%
Local Conservation Groups	53%	51%	44%	49%
Direct Feedback on Practice Effectiveness	65%	70%	86%	94%
University Extension	70%	77%	69%	83%
Your Crop-Adviser/Consultant	64%	77%	78%	88%
Your County Extension Agent	65%	79%	50%	66%
Farm Bureau	40%	48%	37%	51%
Your fertilizer applicator or retailer	74%	75%	77%	79%
NRCS	56%	68%	67%	81%
Family Members	68%	67%	54%	79%
Commodity Groups	32%	41%	32%	44%

Table 39. Farmer guidance source by farmer age

Guidance Source	**<40 years** N=58	**40-60 years** N=214	**60-80 years** N=298	**>80 years** N=27
Other Local Farmers	90%	92%	88%	69%
County Land Conservation Districts	75%	80%	86%	62%
Demonstration Farms	82%	71%	80%	69%
Local Conservation Groups	43%	49%	55%	56%
Direct Feedback on Practice Effectiveness	84%	73%	73%	56%
University Extension	70%	75%	76%	73%
Your Crop-Adviser/Consultant	77%	74%	72%	64%
Your County Extension Agent	68%	63%	69%	77%
Farm Bureau	47%	39%	47%	44%
Your fertilizer applicator or retailer	79%	76%	76%	70%
NRCS	59%	63%	70%	48%
Family Members	86%	64%	67%	56%
Commodity Groups	43%	36%	36%	48%

Cost barriers by program participation and farm size

The following tables seek to address if cost barriers associated with program participation differ between those participating in no program, GLRI programs, government-funded programs, and both GLRI and government funded programs (Table 40). Perceived cost barriers are also compared by farm size to examine if there is a difference in how large and small farms perceive cost challenges (Table 41). Cost barriers were taken from a bank of barriers associated with general incentive program participation. The respondents answered the prompts on a scale where -1 = strongly disagree, 1 = disagree, 0 = neither disagree nor agree, 1 = agree and 2 = strongly agree. ANOVAs with post hoc tests were performed to assess if there were significant difference in the perception of cost barriers by participation and farm size categories.

Respondents generally believe payments associated with government programs to be too small, more than they believe them to be too slow (Table 40). Farmers participating in general government programs, not GLRI specifically, were less likely to think that program payments were too slow while on average, those not participating in programs believed that payments were to slow. This may point to a misconception that farmers hold before enrolling in a program. There were no significant differences in perceived cost barriers between farm size categories.

Table 40. Program cost barriers and program participation (scale: -2 = strongly disagree, 2 = strongly agree)

	No program participation N=381	**GLRI program participation N=27**	**Govt. program participation N=131**	**Both GLRI and govt. program participation N=38**
	Mean (std. dev)	Mean (std. dev)	Mean (std. dev)	Mean (std. dev)
Government-funded program payments are too small	.31 (.81)	.41 (1.08)	.44 (.92)	.32 (.93)
Government-funded program payments are too slow	**.16 (.74)**	-.11 (.97)	**-.08[1] (.95)**	-.13 (.84)

[1] Value is significantly different than value for "no program participation"

Table 41. Program cost barriers and farm size (scale: -2 = strongly disagree, 2 = strongly agree)

	<250 acres N=258	**250-750 acres N= 152**	**750-1500 acres N=82**	**>1500 acres N=59**
	Mean (std. dev)	Mean (std. dev)	Mean (std. dev)	Mean (std. dev)
Government-funded program payments are too small	.30 (.81)	.34 (.86)	.39 (.99)	.47 (.92)
Government-funded program payments are too slow	.07 (.79)	.07 (.81)	.12 (.91)	.07 (.76)

Farmer concerns for managing soil health and passing farm on to next generation, related to practice adoption and program participation

The following tables compare level of concern about soil health (Table 42) and farm succession (Table 43) with conservation use and program participation. For analysis, the concern scale was condensed to low, medium, and high concern. The strong majority of cover crop and buffer adopters had high levels of concern for both soil health and farm succession, as did those not using these two practices. However, overall concern about soil health is lower for those not using cover crops (and a bit lower for those not using buffers), indicating that concern about soil health may be a driver of conservation adoption, in particular cover crop use.

A similar pattern can be observed for concern and program participation, where concern is high for both issues among all categories of participation. However, a greater proportion of participants in government programs indicate high levels of concern about soil health and farm succession than do participants not in government programs. There is no evidence that participants in GLRI programs are more concerned about these issues than participants in other programs, although the greatest proportion of individuals with high concern for soil health were those participating in both GLRI and other government programs.

Table 42. Cover crop and vegetative buffer use and farmer concerns

		Cover crop use		Vegetative buffer use	
		Yes N = 327	No N = 274	Yes N= 255	No N = 336
Concern for managing soil health on your farm	Low concern	1%	4%	0.3%	5%
	Medium concern	24%	37%	30%	30%
	High concern	75%	60%	70%	65%
Concern for passing your farm on to the next generation	Low concern	8%	14%	8%	15%
	Medium concern	24%	24%	24%	25%
	High concern	68%	62%	68%	61%

Table 43. Program participation and farmer concerns (scale: 0 = not at all concerned, 6 = extremely concerned)

		No program participation N=381	**GLRI program participation** N=27	**Govt. program participation** N=131	**Both GLRI and govt. program participation** N=38
Concern for managing soil health on your farm	Low concern	2.9%	-	1.6%	-
	Medium concern	34.0%	25.9%	25.8%	10.5%
	High concern	63.1%	74.1%	72.7%	89.5%
Concern for passing your farm on to the next generation	Low concern	13.4%	3.7%	7.0%	5.3%
	Medium concern	25.9%	29.6%	18.8%	21.1%
	High concern	60.7%	66.7%	74.2%	73.7%

Examining the connection between understanding and action

To address the connection between understanding and action, we examine beliefs regarding farmer responsibility, practice efficacy, knowledge and concern for nutrient loss by practice adoption and program participation. While literature shows that farmers who believe in the off-farm benefits of conservation practices are more likely to adopt the practice and participate in government programs (Reimer, Thompson, & Prokopy, 2012; Yeboah, Lupi, & Kaplowitz, 2015),

environmental awareness in terms of cause and consequence is a weak predictor of whether or not a farmer will engage in conservation (Baumgart-Getz, Prokopy, & Floress, 2012; Prokopy, Floress, Klotthor-Weinkauf, & Baumgart-Getz, 2008).

Farmers who perceive a personal responsibility to help protect their watershed are more likely to be cover crop and buffer users than not (Table 44). This trend is repeated for farmers who believe that actions on their farm have a measurable impact on the watershed and that they are more informed than most about conservation. In general, this indicates that these beliefs may be important drivers of conservation practices, albeit there are other factors at play.

Table 44. Cover crop and vegetative buffer use by responsibility, efficacy, and knowledge

		Cover crop adopters		**Vegetative buffer adopters**	
		Yes N= 328	No N= 277	Yes N= 337	No N=255
It is the responsibility of farmers to help protect watershed	Disagree	5%	7%	3%	9%
	Neither disagree/ agree	17%	27%	18%	25%
	Agree	79%	66%	79%	66%
My actions on my farm have measurable impact on the watershed	Disagree	33%	37%	31%	40%
	Neither disagree/agree	23%	32%	24%	29%
	Agree	44%	32%	44%	31%
I think I am better informed about conservation practices than most farmers	Disagree	9%	15%	11%	12%
	Neither disagree/agree	44%	56%	46%	55%
	Agree	47%	29%	44%	33%

Regardless of program participation status, the majority of farmers believe it is the responsibility of farmers to help protect the watershed (Table 45). However, agreement about responsibility is highest with program participation. Believing that one's actions have a measurable impact and being more informed than most is also more likely among those participating in programs. For example, only 30% of those not participating in programs thought their actions had an impact, while 50 to 55% participating in programs held that belief.

While there is no clear evidence that GLRI participants hold these beliefs more strongly than participants in other programs, there is evidence that these beliefs are greatest among those participating in both GLRI and other government programs. With this data we cannot say that this is a result of participation, in fact, it may be that having these beliefs to begin with drives participation in multiple programs.

Table 45. Program participation and responsibility, efficacy, and knowledge beliefs

		No program participation N=381	**GLRI program participation** N=27	**Govt. program participation** N=131	**Both GLRI and govt. program participation** N=38
It is the responsibility of farmers to help protect watershed	Disagree	6.9%	3.7%	3.9%	-
	Neither disagree/ agree	23.9%	18.5%	16.3%	13.2%
	Agree	69.2%	77.8%	79.8%	86.8%
My actions on my farm have measurable impact on watershed	Disagree	40.4%	25.9%	27.9%	21.1%
	Neither disagree/agree	28.5%	18.5%	20.9%	23.7%
	Agree	31.1%	55.6%	51.2%	55.3%
I think I am better informed about conservation practices than most farmers	Disagree	13.0%	11.1%	7.8%	5.3%
	Neither disagree/ agree	51.9%	48.1%	48.8%	28.9%
	Agree	35.1%	40.7%	43.4%	65.8%

The percent of individuals with high concern about nutrient loss on their own farm was greater among those using both conservation practices (Table 46) and participating in both GLRI or GLRI and other government programs (Table 47). Trends were similar for concern about agriculture in general, although not as pronounced for GLRI versus other government programs. Specifically, both forms of concern are higher for GLRI participants, while concern about ag in general may be more of a driver for general programs (as opposed to concern about one's own farm which may drive participation GLRI). Put another way, GLRI participants may be the most conscientious and concerned about nutrient loss, and therefore seeking out additional opportunities to participate in conservation.

Table 46. Cover crop adoption and concern for nutrient loss impacting the watershed

		Cover crop users		Vegetative buffer users	
		Yes N= 323	No N = 273	Yes N= 334	No N= 252
Concern for nutrient loss from your farm negatively impacting watershed	Low concern	26%	29%	21%	35%
	Medium concern	43%	48%	47%	43%
	High concern	32%	23%	32%	21%
Concern for nutrient loss from agriculture negatively impacting watershed	Low concern	13%	17%	10%	21%
	Medium concern	47%	52%	50%	49%
	High concern	40%	31%	40%	30%

Table 47. Program participation and concern for nutrient loss impacting the watershed

		No program participation N=381	**GLRI program participation** N=27	**Govt. program participation** N=131	**Both GLRI and govt. program participation** N=38
Nutrient loss from your farm negatively impacting watershed	Low concern	36.2%	14.8%	13.4%	2.6%
	Medium concern	42.2%	40.7%	58.3%	42.1%
	High concern	21.6%	44.4%	28.3%	55.3%
Nutrient loss from agriculture negatively impacting watershed	Low concern	20.8%	3.7%	7.1%	-
	Medium concern	48.6%	48.1%	55.1%	42.1%
	High concern	30.5%	48.1%	37.8%	57.9%

Evaluating need for more effective communication of practices to farmers

We examined barriers associated with knowledge and understanding of practices by cover crop and vegetative buffer use (Table 48). Vegetative buffer and cover crop use is strongly associated with higher levels of knowledge, greater exposure to the practice on a similar farm and less uncertainty of the benefits. In particular, farmers using cover crops and buffers are much more likely to report not being limited at all, and much less likely to report being limited a

some or a lot by these three barriers. The results suggest that conservation staff should be increasing demonstration opportunities for future cover crop and vegetative buffer users and increasing understanding about practices and their benefits.

Table 48. Cover crop adoption and practice understanding and awareness barriers

		Cover crop use		**Vegetative buffer use**	
	Barriers limit ability to implement	Yes N= 326	No N= 269	Yes N= 337	No N= 242
Lack of knowledge about the practice	Not at all	53%	38%	70%	38%
	A little	30%	28%	19%	26%
	Some	14%	29%	10%	20%
	A lot	2%	6%	1%	15%
Not being able to see a demonstration of the practice on a farm like mine	Not at all	72%	50%	78%	46%
	A little	21%	21%	17%	26%
	Some	6%	21%	5%	16%
	A lot	1%	4%	1%	5%
Uncertainty about the benefits of this practice on my farm	Not at all	60%	33%	67%	29%
	A little	29%	27%	20%	31%
	Some	9%	30%	10%	24%
	A lot	3%	9%	3%	16%

Exploring the relationship between practice-specific efficacy and practice use

As mentioned previously, literature supports the belief that increased belief in the effectiveness of conservation practices increased the likelihood of adoption. Comparing these beliefs for the farm and the watershed indicates that cover crop and buffers users are much more likely to belief that these practices can reduce nutrient loss and improve water quality (Table 49). This supports the finding that efficacy may influence adoption, and that conservation professionals should target increasing the perception of practice effectiveness among farmers.

Table 49. Perceived practice-specific efficacy and practice use

		Cover crop use		**Vegetative buffer use**	
		Yes N= 326	No N=276	Yes N= 335	No N= 254
Cover crops/buffers can reduce nutrient loss on my farm	Disagree	14%	16%	9%	18%
	Neither disagree/agree	10%	30%	21%	36%
	Agree	78%	54%	69%	47%
Widespread adoption of cover crops/buffers can improve water quality in watershed	Disagree	4%	10%	7%	8%
	Neither disagree/agree	18%	39%	18%	26%
	Agree	78%	51%	76%	67%

Barriers to practice implementation and program participation by farm size

When addressing barriers to implementation and participation, outreach professionals may need to consider that barriers are not equally experienced across operations of different sizes and capacities. For practice adoption, respondents were asked how much several barriers limit their ability to implement cover crop and vegetative buffers. Barriers were scaled from 1 = not at all to 4 = a lot. For program participation, barriers were framed as statements and responses were scaled from -2 = strongly disagree to 2 = strongly agree with each statement. The tables are organized by the strongest to lowest perceived barrier, by the smallest farm size category. An ANOVA with post hoc tests determined whether the differences in perceived barriers differ by farm size. Bolded statements indicate that there was a significant difference ($p= \leq .05$) among the mean response between one or more farm size categories. If the differences were between three of more categories, the mean response that was different from others has an asterisk.

For conservation practice use, smaller farms (compared to larger farms) report a lack of knowledge as a greater barrier for both cover crops and buffers (Tables 50 and 51), while they also find access to equipment and not seeing the practice on a farm like theirs bigger barriers for buffers (Table 51). This finding is intuitive in that larger farms are more likely to have the resources and capacity to purchase equipment and seek assistance on implementing new practices. However, larger farms report greater barriers associated with uncertainty in the weather and time when it comes to implementing cover crops (Table 50). This is again intuitive given the amount of acreage they have to cover with this practice, and the challenge of doing so under increasingly short windows of opportunity.

For program participation, larger farms (the biggest farms in particular) report being more limited by restrictions on how land in programs is managed and a lack of flexibility to meet their own farming needs (Table 52). Interestingly, their interest in programs is significantly higher than the smallest farms, and generally speaking, interest in programs increases with farm size. While many of the barriers measured pose a similar challenge (or lack thereof) across farm sizes, there are a few barriers that vary and could be more carefully addressed in program design to encourage a broad range of participation.

Table 50. Cover crop barriers and farm size (scale: 1 = not a barrier, 4 = strong barrier)

How barriers limit ability to implement cover crops	**<250 acres** N=~ 261		**250-750 acres** N=~151		**750-1500 acres** N=~81		**>1500 acres** N=59	
	Mean	Std. dev	Mean	Std. dev	Mean	Std. dev	Mean	Std. dev
Uncertainty in the weather	**1.36***	1.09	**1.72**	1.09	**1.8**	0.91	**1.86**	1.01
Lack of the right equipment	1.34	1.14	1.19	1.02	1.11	1.08	1.12	1.04
The lack of an immediate economic return	1.23	1.07	1.26	0.96	1.31	0.96	1.29	1.1
Too many restrictions associated with using the practice	1.08	1.11	0.99	1.05	1.01	1.02	1	1.08
Too time consuming to manage	**1.01**	0.94	**1.08**	0.92	**1.32***	0.85	1.1	0.92
The contracts providing incentives are too short	0.99	1.05	0.93	0.95	1.04	1.05	0.95	1.04
Lack of knowledge about the practice	**0.95**	0.95	0.74	0.81	0.78	0.87	**0.54**	0.84
Requires too many changes in my daily operation	0.88	0.97	0.79	0.8	0.88	0.81	0.97	0.98
Uncertainty about the benefits of this practice for my farm	0.86	0.97	0.77	0.86	0.86	0.86	0.63	0.95
No demonstration of the practice on a farm like mine	0.69	0.99	0.54	0.76	0.53	0.78	0.5	0.73
Lack of technical assistance	0.69	0.89	0.61	0.83	0.69	0.9	0.51	0.73
Not wanting to use the practice on rented ground	0.59	0.95	0.73	0.91	0.64	0.86	0.58	0.89

Table 51. Vegetative buffer barriers and farm size (scale: 1 = not a barrier, 4 = strong barrier)

How barriers limit ability to implement vegetative buffers	**<250 acres** N= ~248		**250-750 acres** N= ~150		**750-1500 acres** N= ~81		**>1500 acres** N= 58	
	Mean	Std. dev	Mean	Std. dev	Mean	Std. dev	Mean	Std. dev
Not wanting to lose land for production	1.19	1.15	1.28	1.16	1.36	1.08	1.4	1.12
Too many restrictions associated with using the practice	1.14	1.06	1.16	1.07	1.42	0.99	1.47	1.13
The lack of an immediate economic return	1.08	1.09	1.05	1.1	1.19	0.98	1.1	1.09
Lack of the right equipment	**0.97**	1.12	0.76	0.98	0.83	0.97	**0.53**	0.8
Uncertainty in the weather	0.93	1.08	1.03	1.09	1.01	1	0.93	1.11
The contracts providing incentives are too short	0.93	1.07	0.84	0.95	1.01	0.99	1.16	1.25
Too time consuming to manage	0.9	0.91	0.79	0.92	0.91	0.86	0.9	0.81
Uncertainty about benefits of this practice for my farm	0.89	1	0.78	0.99	0.79	0.96	0.67	0.98
Lack of knowledge about the practice	**0.81**	0.97	0.75	1.01	0.62	0.89	**0.4**	0.75
Lack of technical assistance	0.68	0.89	0.55	0.83	0.55	0.79	0.5	0.8
Not wanting to use the practice on rented ground	0.67	1.01	0.82	1.03	0.99	0.98	0.98	1.1
Requires too many changes in my daily operation	0.65	0.88	0.67	0.86	0.6	0.77	0.74	0.83
No demonstration of the practice on a farm like mine	**0.64**	0.94	**0.61**	0.89	0.45	0.76	**0.26***	0.69

Table 52. Program barriers and farm size (scale: 1 = not a barrier, 4 = strong barrier)

Government-funded program barriers	**<250 acres** N= ~258		**250-750 acres** N= ~152		**750-1500 acres** N= ~82		**>1500 acres** N= 59	
	Mean	Std. dev	Mean	Std. dev	Mean	Std. dev	Mean	Std. dev
Too many restrictions on how land in programs is managed	**0.46**	0.93	**0.45**	0.86	**0.44**	1.02	**0.64***	0.91
The program payments are too small	0.3	0.81	0.34	0.86	0.39	0.99	0.47	0.92
I would prefer payments based on actual reductions in nutrient loss	0.2	0.78	0.15	0.84	0.21	0.87	0.26	0.85
Programs are not flexible to specific needs of farm	**0.08**	0.9	**0.03**	0.94	**0.01**	0.85	**0.41***	1
The program payments are too slow	0.07	0.8	0.07	0.81	0.12	0.91	0.07	0.76
Too much paperwork required	-0.01	0.75	0.08	0.82	0.07	0.92	0.17	0.79
Practices are not long enough to start paying for itself	-0.07	0.65	-0.22	0.69	-0.07	0.77	0	0.94
Information about programs is not readily available	-0.15	0.91	-0.23	0.91	-0.21	0.97	-0.19	0.94
I am not interested in participating in programs	**-0.15**	1.11	-0.32	1.07	-0.6	0.98	**-0.71**	1.04

Cover crop and buffer use by proportion of total farm acres rented

The percent of cover crop and vegetative buffer use increases as the percentage of rented acres decreases (Table 53). The majority of cover crop and vegetative buffer users fall in the category of less than 25% rented acres. Less than ten percent of those who rent 75-100% of their acres are currently using cover crops or vegetative buffers. This reveals a gap in engagement or flexibility for renters to adopt cover crops and vegetative buffers.

Table 53. Cover crop adoption and proportion of acres rented

Percentage rented acres	**Currently using cover crops** N=332	**Currently using vegetative buffers** N=342
<25%	49.5%	51.3%
25-50%	23.1%	21.2%
50-75%	18.8%	19.1%
75-100%	8.5%	8.4%

Decision making of renters by age group and farm size

For those with rented acreage, we compared their decision making authority with their age (Table 54) and farm size (Table 55). We see that sole decision making authority is highest for those in the 40-60 year old age range, and lowest for both those under 40 and over 80. We also see a greater tendency for those under 40 to be making decisions in consultation with their landlord (Table 54). In terms of farm size, we see a greater tendency for those on the largest farms (greater than 1500 acres) to be making decisions in consultation with a landlord (perhaps representing the reality that they rent much more land on average).

Table 54. Decision making by renters and age

Decision making	**<40 years** N=58	**40-60 years** N=214	**60-80 years** N=298	**>80 years** N=27
Me alone	52.8%	70.9%	63.0%	53.8%
Me with landlord	44.4%	23.4%	31.8%	30.8%
Landlord alone	2.8%	2.8%	3.9%	-
Other	-	2.8%	1.3%	15.4%

Table 55. Decision making by renters and farm size

Decision making	**<250 acres** N=272	**250-750 acres** N=158	**750-1500 acres** N=82	**>1500 acres** N=59
Me alone	70.7%	64.5%	72.6%	56.6%
Me with landlord	24.2%	27.3%	25.8%	37.7%
Landlord alone	4.0%	3.6%	1.6%	1.9%
Other	1.0%	4.5%	-	3.8%

Section 3: Exploring cover crop and vegetative buffer adoption and government program participation

Who is interested in government programs?

To investigate interest, we used a linear regression to compare how several variables impact the likelihood of a farmer being interested in government incentive programs. The dependent variable, stated interest, was measured on a scale of -2 strongly disagree (strong disinterest) to 2 strongly agree (strong interest). Table 56 displays the statistically significant predictors of program interest. The direction of the arrow signifies the effect the predictor had on program interest. For example, as education level increases, the likelihood of a farmer being interested in a program increases. **Specifically, interest in participation increases among younger farmers, more educated farmers, and those with greater response efficacy (stronger belief that practices are beneficial).**

Table 56. Predicting program interest

	Effect on Interest	Sig.
Farm Size	↑	.054
Age	↓	.032
Education	↑	.018
Broad response efficacy	↑	.008
Cover crops response efficacy	↑	.029
Grass buffers response efficacy	↑	.000

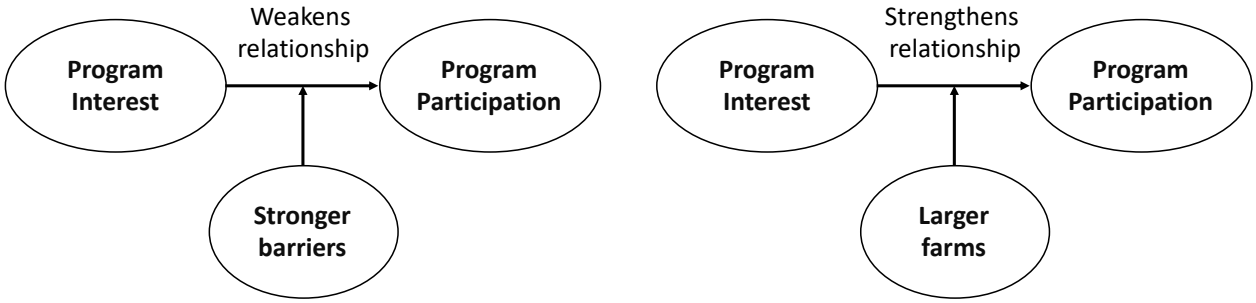
[1]Variables tested but not significant: CC/VB adoption, farm-level/watershed-level concern, conservationist/productivist identity, responsibility, practice knowledge

Why isn't everyone who is interested participating?

After determining the farm and farmer characteristics that influence interest in government programs, we explored what stops this interest from translating to program participation. Figure 4 shows the conceptual model in which program barriers and farm size are proposed to decrease the positive relationship between program interest and participation. In other words,

farmers who hold high interest are expected to be likely to participate in programs. However, increasing program barriers and decreasing farm size could negatively impact this relationship.

Figure 4. Program barriers and farm characteristics moderating the relationship between program interest and participation



The barriers displayed in bold significantly weaken the relationship between program interest and participation (Table 57). Specifically, **the barriers that lessened the odds of interest influencing participation were related to program structure (i.e., information access, flexibility, restrictions), and not related to payment structure.**

When farm size was applied as a moderator to the relationship between program interest and current participation, we found that **large farms were more likely to participate in programs even when program interest was low, and small farms only have a high likelihood of participation when interest is high.** *For scatter plot depicting analysis, see Appendix B.*

Table 57. Barriers that significantly weaken the relationship between program interest and participation in bold

Barriers
Information about government programs is not readily available
Programs are not flexible to meet the specific needs of my farm
There are too many restrictions on how land in programs is managed
Programs are not long enough to allow the practice to start paying for itself
The program payments are too small
The program payments are too slow
I would prefer if payments were based on actual reductions in nutrient loss
I would prefer if payments were higher to start but decreased over time
There is too much paperwork required to participate

How do farm and farmer characteristics change thinking that impacts adoption?

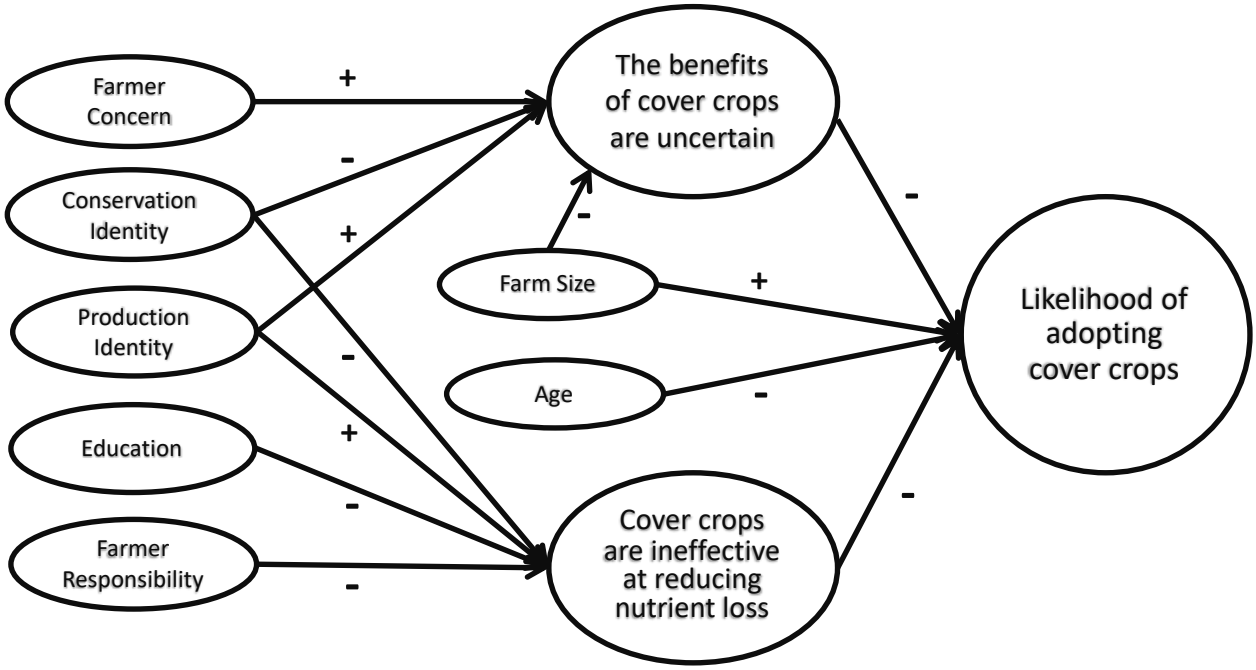
To investigate how farm and farmer characteristics might impact adoption of conservation practices, we conducted a series of mediated regression analyses. We use these analyses to identify the extent to which differences in farm and farmer characteristics barriers impact adoption by changing how farmers think about different conservation practices. Specifically, we investigated how farm and farmer characteristics may directly increase or decrease adoption, but also how they may impact adoption by changing farmer's uncertainty about the benefits of the practices on their farm and their perception of the ineffectiveness of the practice at reducing nutrient loss on their farm. The mediation analyses allow us to identify the extent to which different farm and farmer characteristics impact adoption in three ways:

1) by changing perceptions of the ineffectiveness of the practice
2) by changing the amount of uncertainty about the benefits of the practice
3) through some other process that we did not directly measure, meaning that the characteristic has a direct impact on adoption.

The results of these analyses suggest that for cover crop adoption (see Fig. 5), there are several characteristics that only indirectly impact adoption by changing perceptions about the benefits and the ineffectiveness of cover crops. Only two characteristics directly impact adoption. Specifically:

- **Younger farmers and larger farms are more likely to adopt**, not because of differences in perceived uncertainty or effectiveness, but due to other factors we didn't measure.
- **Larger farms are less uncertain about the benefits of cover crops.**
- **Farmers with stronger productivist identities show more uncertainty about the benefits of cover crops and greater perceptions of ineffectiveness (and subsequently lower adoption)**
- **Farmers with stronger conservationist identities show less uncertainty about the benefits of cover crops and lower perceptions of ineffectiveness (and subsequently greater adoption)**
- **Farmers with more formal education and those who perceive a greater responsibility for the health of the lake, show lower perceptions of ineffectiveness (and subsequently higher adoption).**

Figure 5. Mediated regression predicting cover crop adoption from farm and farmer characteristics through uncertainty and effectiveness beliefs where a "positive" arrow indicates that as one variable goes up the other does too, and a "negative" arrow indicates t



*Having more rented acreage, higher watershed-level concern, perceiving that the government is responsible for lake health, greater self-efficacy or confidence in one's ability to implement cover crops, and greater beliefs that the practices needed to manage every farm are unique were included in the analysis, but were not significant predictors of uncertainty, ineffectiveness, or adoption

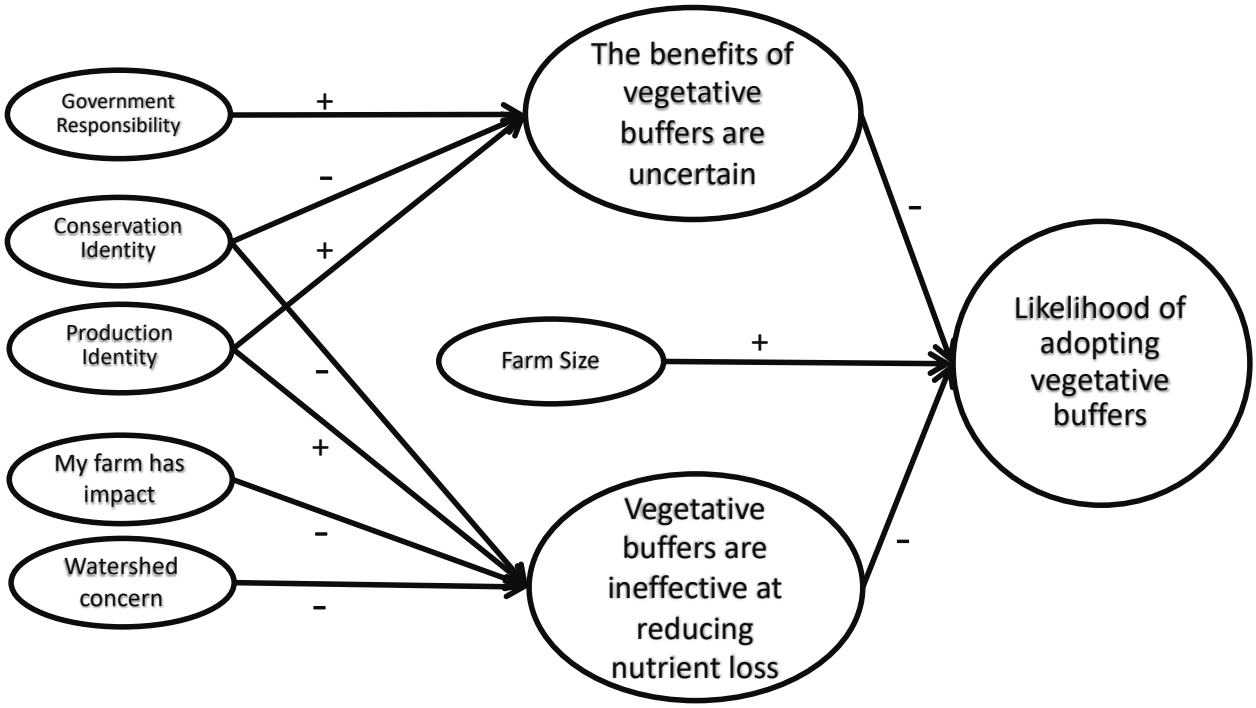
The results of these analyses suggest that for vegetative buffer adoption (see Fig. 6), there are again several characteristics that only indirectly impact adoption by changing perceptions about the benefits and the ineffectiveness of cover crops. Only one characteristic directly impacts adoption. Specifically:

For adoption:

- Similar to cover crops, **larger farms are more likely to adopt vegetative buffers**, not because of differences in perceived uncertainty or effectiveness, but due to other factors we didn't measure.
- **Similar to cover crops, farmers with stronger productivist identities show more uncertainty about the benefits of cover crops and greater perceptions of ineffectiveness (and subsequently lower adoption)**

- **Similar to cover crops, farmers with stronger conservationist identities show less uncertainty about the benefits of cover crops and lower perceptions of ineffectiveness (and subsequently greater adoption)**
- **Those who believe it's the government's responsibility to protect the lake are more uncertain about the benefits (and subsequently less likely to adopt)**
- **Farmers who are more concerned about the watershed and those who believe their actions have an impact are less likely to consider buffers to be ineffective (and subsequently less likely to adopt).**

Figure 6. Mediated regression predicting vegetative buffer adoption from farm and farmer characteristics through uncertainty and effectiveness beliefs where a "positive" arrow indicates that as one variable goes up the other does too, and a "negative" arrow indicates that as one variable goes up the other goes down.



* Being older or more educated, having more rented acreage, higher farm-level concern, greater perceived personal responsibility, and stronger beliefs that the practices needed to manage every farm are unique were factors included in the analysis, but they were not significant predictors of uncertainty, ineffectiveness, or adoption

Appendix A. Survey

Researching the Effectiveness of Agricultural Programs

A study conducted by:

In cooperation with:

Specific advisory partner logos based on particular watershed

Please respond to each question with the answer you believe is most representative of you and your farm. There are no wrong or right answers; we are only interested in your opinion. Please note that you do not have to answer an item that you feel is too personal or sensitive.

1. Did you operate a farm in 2018?

☐ Yes ☐ No

2. Do you plan to operate a farm in 2019?

☐ Yes ☐ No

If your answer is NO to either question 1 or 2, please return the survey without completing it in the enclosed envelope. Postage is paid by the survey project. Otherwise, please continue…

3. Please circle the number that best represents how concerned you are about the following issues.

	Not at all concerned						**Extremely concerned**
a. Nutrient loss on your farm	0	1	2	3	4	5	6
b. Nutrient loss from your farm negatively impacting [insert your Lake]	0	1	2	3	4	5	6
c. Nutrient loss from agriculture negatively impacting [insert your Lake]	0	1	2	3	4	5	6
d. Additional government regulation or rules related to ag nutrient loss	0	1	2	3	4	5	6
e. A lawsuit filed against farmers because of nutrient loss to [insert your Lake]	0	1	2	3	4	5	6
f. Soil health on your farm	0	1	2	3	4	5	6
g. The management decisions of other farmers in your community	0	1	2	3	4	5	6
h. Your ability to make an annual profit as a farmer	0	1	2	3	4	5	6
i. Your ability to pass on your farm to the next generation	0	1	2	3	4	5	6

4. Please indicate your level of agreement or disagreement with the statements below by circling the number that best represents your opinion.

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
a. It is the responsibility of farmers to help protect [insert your Lake].	-2	-1	0	1	2
c. My actions on my farm have no measurable impact on [insert your Lake].	-2	-1	0	1	2
e. I am not willing to change my current practices to improve water quality.	-2	-1	0	1	2
f. The quality of life in my community depends on good water quality in [insert your Lake].	-2	-1	0	1	2
g. It is the responsibility of the government to protect [insert your Lake].	-2	-1	0	1	2
h. Agriculture is not the main driver of algal blooms in [insert your Lake].	-2	-1	0	1	2
i. Practices that benefit water quality also benefit my farm.	-2	-1	0	1	2
j. I am unsure of what steps to take to reduce nutrient loss on my farm.	-2	-1	0	1	2
k. I think I am better informed about conservation practices than most farmers.	-2	-1	0	1	2
l. Widespread adoption of cover crops can improve water quality in [insert your Lake].	-2	-1	0	1	2
m. Cover crops cannot reduce nutrient loss on my farm.	-2	-1	0	1	2
l. Widespread adoption of grass buffers can improve water quality in [insert your Lake].	-2	-1	0	1	2
m. Grass buffers cannot reduce nutrient loss on my farm.	-2	-1	0	1	2
n. The practices needed to reduce nutrient loss are unique to each farm.	-2	-1	0	1	2

The following questions will ask about specific adoption and management of two well-known conservation practices. We will begin with cover crops.

1. Are you currently using cover crops on your farm?

☐ No (skip to question 3) ☐ Yes → For how many years? _____

2. On what percent of your total farm acres do you currently use cover crops?

☐ A few (0-25%) ☐ Some (25-50%) ☐ A lot (50-75%) ☐ Most (75-100%)

3. How likely are you to use cover crops on your farm next year?

☐ Will not use ☐ Unlikely to use ☐ Likely to use ☐ Will definitely use

4. How likely are you to use cover crops in the future without incentives?

☐ Will not use ☐ Unlikely to use ☐ Likely to use ☐ Will definitely use

5. How much do the following factors limit your ability to implement cover crops?

	Not at all	A little	Some	A lot
a. Lack of information/knowledge	0	1	2	4
b. Too time consuming to manage	0	1	2	3
d. Lack of equipment	0	1	2	3
e. Not being able to see a demonstration of the practice on a farm like mine	0	1	2	3
f. The amount of rental acreage I farm	0	1	2	3
g. Lack of technical assistance	0	1	2	3
h. Unsure about the benefits of this practice for my farm	0	1	2	3
i. Not being able to harvest the cover crop	0	1	2	3
j. Uncertainty in the weather	0	1	2	3
k. The lack of an immediate economic return	0	1	2	3
l. Too many operational changes required	0	1	2	3
m. The restrictions associated with using the practice (e.g., can't harvest cover crops)	0	1	2	3
n. The government contracts are too short	0	1	2	3

6. How will the adoption of cover crops impact the net costs of production on your farm? Please consider net costs of production over both the short and the long-term:

	Net costs of production	Strongly decrease	Slightly decrease	Neither decrease nor increase	Slightly increase	Strongly increase
Short term (0-5 years)	Labor and time	-2	-1	0	1	2
	Fuel and equipment	-2	-1	0	1	2
	Fertilizer and chemicals	-2	-1	0	1	2
	Seeds	-2	-1	0	1	2
Long term (6 -10 years + beyond)	Labor and time	-2	-1	0	1	2
	Fuel and equipment	-2	-1	0	1	2
	Fertilizer and chemicals	-2	-1	0	1	2
	Seeds	-2	-1	0	1	2

7. Now, consider how the adoption of cover crops might impact the following benefits on the land you farm. Please consider the benefits of adoption in the following time frames:

	Benefit of Adoption	Strongly decrease	Slightly decrease	Neither decrease nor increase	Slightly increase	Strongly increase
Short term (0-5 years)	Soil structure and health	-2	-1	0	1	2
	Yield resiliency	-2	-1	0	1	2
	Profit-per-acre	-2	-1	0	1	2
Long term (6-10 years + beyond)	Soil structure and health	-2	-1	0	1	2
	Yield resiliency	-2	-1	0	1	2
	Profit-per-acre	-2	-1	0	1	2

Now, we would like you to answer those same questions for vegetative buffers on your farm (e.g., grassed waterways, filter strips, etc).

8. Do you currently have any vegetative buffers on your farm?

☐ No (skip to question 9) ☐ Yes → For how many years? _____

9. Along what percent of your total farm acres do you have vegetative buffers?

☐ A few (0-25%) ☐ Some (25-50%) ☐ A lot (50-75%) ☐ Most (75-100%)

10. How likely are you to add planted buffers to your farm next year?

☐ Will not add ☐ Unlikely to add ☐ Likely to add ☐ Will definitely add

10. How likely are you to add planted buffers in the future without incentives?

☐ Will not add ☐ Unlikely to add ☐ Likely to add ☐ Will definitely add

11. How much do the following factors limit your ability to implement vegetative buffers?

	Not at all	A little	Some	A lot
a. Lack of information/knowledge	0	1	2	4
b. Too time consuming to manage	0	1	2	3
d. Lack of equipment	0	1	2	3
e. Not being able to see a demonstration of the practice on a farm like mine	0	1	2	3
f. The amount of rental acreage I farm	0	1	2	3
g. Lack of technical assistance	0	1	2	3
h. Unsure about the benefits of this practice for my farm	0	1	2	3
i. Loss of land for commodity production	0	1	2	3
j. Uncertainty in the weather	0	1	2	3
k. The lack of an immediate economic return	0	1	2	3
l. Too many operational changes required	0	1	2	3
m. Too many restrictions associated with using the practice (e.g., buffers too wide)	0	1	2	3
n. The government contracts are too short	0	1	2	3

1. People have different opinions about what makes a "good farmer." Please circle the number that best represents how important each of the following items is to your definition of a good farmer.

A good farmer is one who…	Not important at all	Slightly important	Somewhat important	Important	Very important
a. …has the highest yields per acre	0	1	2	3	4
b. …gets their crops planted first	0	1	2	3	4
c. ...considers the health of waterways that run through or along their land to be their responsibility	0	1	2	3	4
d. …minimizes soil erosion	0	1	2	3	4
e. …has the highest profit per acre	0	1	2	3	4
f. …has the most up-to-date equipment	0	1	2	3	4
g. …minimizes nutrient runoff into waterways	0	1	2	3	4
h. …uses the latest seed and chemical technology	0	1	2	3	4
i. …thinks beyond their own farm to the social and ecological health of their watershed	0	1	2	3	4
j. …maintains or increases soil organic matter	0	1	2	3	4
k. …manages for both profitability and minimization of environmental impact	0	1	2	3	4
l. …adopts conservation practices despite challenges	0	1	2	3	4
m. …challenges the belief that agriculture causes water quality issues	0	1	2	3	4
o. …leaves the land in a better condition than when they received it	0	1	2	3	4

2. How much do you rely on the following sources for information when introducing and managing new conservation practices on your farm. Please *circle the number* that best represents to what extent you currently rely on these sources for guidance, *and check the box* in the last column if you would like more information and/or guidance from these sources.

When adopting new conservation practices, how much do you rely on guidance from…	Not at all	Some	A lot	Would like to see more!
a. Other local farmers	0	1	2	☐
b. County land conservation districts	0	1	2	☐
c. Demonstration farms, field days, etc.	0	1	2	☐
d. Local conservation groups (e.g., The Nature Conservancy)	0	1	2	☐
e. Direct feedback on practice effectiveness on your farm (e.g., edge of field monitoring)	0	1	2	☐
f. University extension	0	1	2	☐
g. Your crop adviser/ consultant	0	1	2	☐
h. Your county Extension agent	0	1	2	☐
i. Farm Bureau	0	1	2	☐
j. Your fertilizer applicator or retailer	0	1	2	☐
k. Natural Resources Conservation Service (NRCS)	0	1	2	☐
l. Family members	0	1	2	☐
m. Commodity groups	0	1	2	☐
n. Other (fill-in): _____	0	1	2	☐
o. Other (fill-in): _____	0	1	2	☐

1. Are you currently enrolled in any government-funded incentive programs for conservation?

- ☐ No (Skip to 3)
- ☐ Yes → From what source/program (list all that apply):

  _____

2. How likely are you to continue the funded conservation practices once incentives have stopped?

☐ Will not continue ☐ Unlikely to continue ☐ Likely to continue ☐ Will definitely continue

2. Whether or not you participate in government incentive programs, *please indicate to what extent you agree or disagree with the following statements.*

	Strongly Disagree	**Disagree**	**Neither Agree nor Disagree**	**Agree**	**Strongly Agree**
a. Information about incentive programs is readily available.	-2	-1	0	1	2
h. Programs are flexible to meet the specific needs of my farm.	-2	-1	0	1	2
i. I am not interested in participating in incentive programs.	-2	-1	0	1	2
j. Programs are long enough to allow the practice to start paying for itself.	-2	-1	0	1	2
k. The payment structures of existing programs are fair.	-2	-1	0	1	2
l. The program payments are too slow.	-2	-1	0	1	2
n. I would prefer if incentives were based on actual reductions in nutrient loss (e.g., pay for performance).	-2	-1	0	1	2
o. I would prefer if payments were higher to start but decreased over time.	-2	-1	0	1	2
p. There is too much paperwork required to participate.	-2	-1	0	1	2
q. There are too many restrictions on how land in programs is managed.	-2	-1	0	1	2

This last section tells us a bit more about you and your farm so that we can understand how the effectiveness of conservation programs and practices may vary by different farms. Please note that you do not have to answer an item that you feel is too personal or sensitive.

1. Are you: ☐ Male ☐ Female

2. What is your age? _____ years

3. How much formal education have you completed?

- ☐ Some high school, no diploma
- ☐ High school degree or equivalent
- ☐ Some college, no degree
- ☐ Associate's or bachelor's degree
- ☐ Graduate or professional degree

4. How many years have you been farming?
____ years

5. How many generations has your family been farming some portion of your current operations?

- ☐ I am a first generation farmer
- ☐ I am a second generation farmer
- ☐ I am a third generation farmer or more

6. When you retire, your farm will: *(Check the one that best fits your situation)*

- ☐ Be operated by someone related to me
- ☐ Be operated by someone who is not related to me
- ☐ Be converted into non-farm use or have its development rights sold
- ☐ Be donated to a farmland preservation program
- ☐ Uncertain

7. This past year, what was your **total farm operation's** annual net income?

- ☐ Less than $50,000
- ☐ $50,000 - $99,000
- ☐ $100,000 - $249,999
- ☐ $500,000 or greater

8. Do you or your spouse receive off-farm income? (Check all that apply)

- ☐ Me
- ☐ My spouse
- ☐ No off-farm income

9. If you or your spouse receives off-farm income, what was your annual gross household income from off-farm sources this past year?

- ☐ Less than $10,000
- ☐ $10,000 - $49,999
- ☐ $50,000 - $99,999
- ☐ $100,000 or more

10. How large is your **total farm operation**? For total acres, include cropland, woodland, pasture, wasteland, land in farmsteads, and land in government programs. Under planted acres, include any on which a crop was planted for harvest, including hay, this past year.

	Owned	**Rented**
Total Acres	a. _____	d. _____
Planted Acres	b. _____	e. _____
# of Fields	c. _____	f. _____

11. Did you raise any livestock or poultry on your farm in 2018?

☐ No *(If no, please skip Question 12)*

☐ Yes→ Roughly how many of each did you raise or manage in 2018? *(Please fill in the number below)*

_____ Dairy cows

_____ Beef cows

_____ Calves, heifers, feeders

_____ Swine (1 time capacity)

_____ Poultry (1 time capacity)

12. Across your **total farm operation**, what % of your planted acreage was in each type of tillage this past year? *(Please fill in a number for each)*

_____% Conventional (30% residue or less)

_____% Conservation (30-90% residue)

_____% No-till (90% residue or more)

13. Do you currently have a nutrient management plan for your farm?

☐ No (Skip to Question 14)

☐ Yes → On what percent of your total farm acres do you implement your nutrient management plan?

☐ A few (0-25%)

☐ Some (25-50%)

☐ A lot (50-75%)

☐ Most (75-100%)

14. Do you rent any of the land that you actively manage?

☐ No (Skip to Question 18)

☐ Yes → Who is primarily responsible for conservation decisions on land you rent?

☐ Me alone

☐ Me with landlord

☐ Landlord alone

☐ Other _____

→ How long have you rented this land? _____ years

15. In general, do you have a formally written lease agreement with your landlord/ tenant?

☐ No

☐ Yes → Do any of your leases contain conservation requirements?

☐ No

☐ Yes

16. For how many more years are you confident if your ability to keep renting this land?

☐ 2 years or less

☐ 3-5 years

☐ More than 5 years

17. In general, is your landlord/ tenant a member of your local community?

☐ No

☐ Yes

☐ Not sure

18. What is the name of the county and township in which your main farming operation resides?

County _____

Township _____

Zipcode _____

Thank you for taking our survey. The return postage has already been paid, so simply fold the survey and place it in the postage-paid envelope, and put it in your mailbox.

If you have any other feedback regarding federal incentive programs please leave it here! ***In particular, we would be interested in knowing what conservation practices you would like to do that are currently not supported by government programs.***

Appendix B. Non-response follow-up survey

1. Did you operate a farm in 2018?

☐ Yes ☐ No

2. Are you operating a farm in 2019?

☐ Yes ☐ N

3. Please indicate your level of agreement or disagreement with the statements below by circling the number that best represents your opinion.

	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
a. It is the responsibility of farmers to help protect Lake Ontario.	-2	-1	0	1	2
b. My actions on my farm have no measurable impact on Lake Ontario.	-2	-1	0	1	2
c. I am not willing to change my current practices to improve water quality	-2	-1	0	1	2
d. I think I am better informed about conservation practices than most farmers.	-2	-1	0	1	2
e. Agriculture is not the main driver of algal blooms in Lake Ontario.	-2	-1	0	1	2
f. Information about government programs is readily available.	-2	-1	0	1	2
g. There are too many restrictions on how land in programs is managed.	-2	-1	0	1	2

4. People have different opinions about what makes a "good farmer." Please circle the number that best represents how important each of the following items is to your definition of a good farmer.

A good farmer is one who…	Not important at all	Slightly important	Somewhat important	Important	Very important
d. …minimizes soil erosion	0	1	2	3	4
g. …minimizes nutrient runoff into waterways	0	1	2	3	4

5. Are you currently using cover crops on your farm?

☐ No ☐ Yes

6. Do you currently have any vegetative buffers on your farm?

☐ No ☐ Yes

7. Do you currently raise any livestock of poultry on your farm?

☐ No ☐ Yes

8. Do you currently have a nutrient management plan for you farm?

☐ No ☐ Yes

9. What is the size of your total farm operation?

☐ Less than 250 acres
☐ 250 to 749 acres
☐ 750 to 1500 acres
☐ Greater than 1500 acres

10. What percent of your total farm operation is rented?

☐ 0-25% ☐ 25-50% ☐ 50-75% ☐ 75-100%

11. How many years have you been farming?

_____ years

12. Do you or your spouse receive off-farm income?

☐ No ☐ Yes

13. Have you participated in any Great Lakes Restoration Initiative (GLRI) funded programs?

☐ No ☐ Yes ☐ Unsure

14. Are you currently enrolled in any other government-funded programs for conservation?

☐ No ☐ Yes

15. What is the name of the county where your main farming operation is located?

County _____

Appendix C. Farm Size Moderator Scatter Plot

Figure 11 displays a scatter plot depicting program farm size as a moderator between program interest and the odds of participating in a government program. Each line represents the average farm size bin (1= <250 acres, 2 = 250-750 acres, 3= 750-1500 acres, 4 = >1500 acres) and one standard deviation above and below. At a level of low program interest, larger farms (blue line) have higher odds of participating in government programs. Moving left to right along program interest shows that for a small farmer, interest has to be very high to be likely to participate in government programs (i.e., high interest can overcome being a small farm).

Figure 7. Program interest and participation by farm size